DOCUMENT RESUME

ED 099 229 88 SE 018 432

AUTHOR Junglas, Mary R.; And Others
TITLE Environmental Learning Experiences: Bio-Physical, Junior High School.
INSTITUTION Willoughby-Eastlake School District, Willoughby, Ohio.
SPONS AGENCY Bureau of Elementary and Secondary Education (DHEW/OE), Washington, D.C.
PUB DATE 74
NOTE 97p.

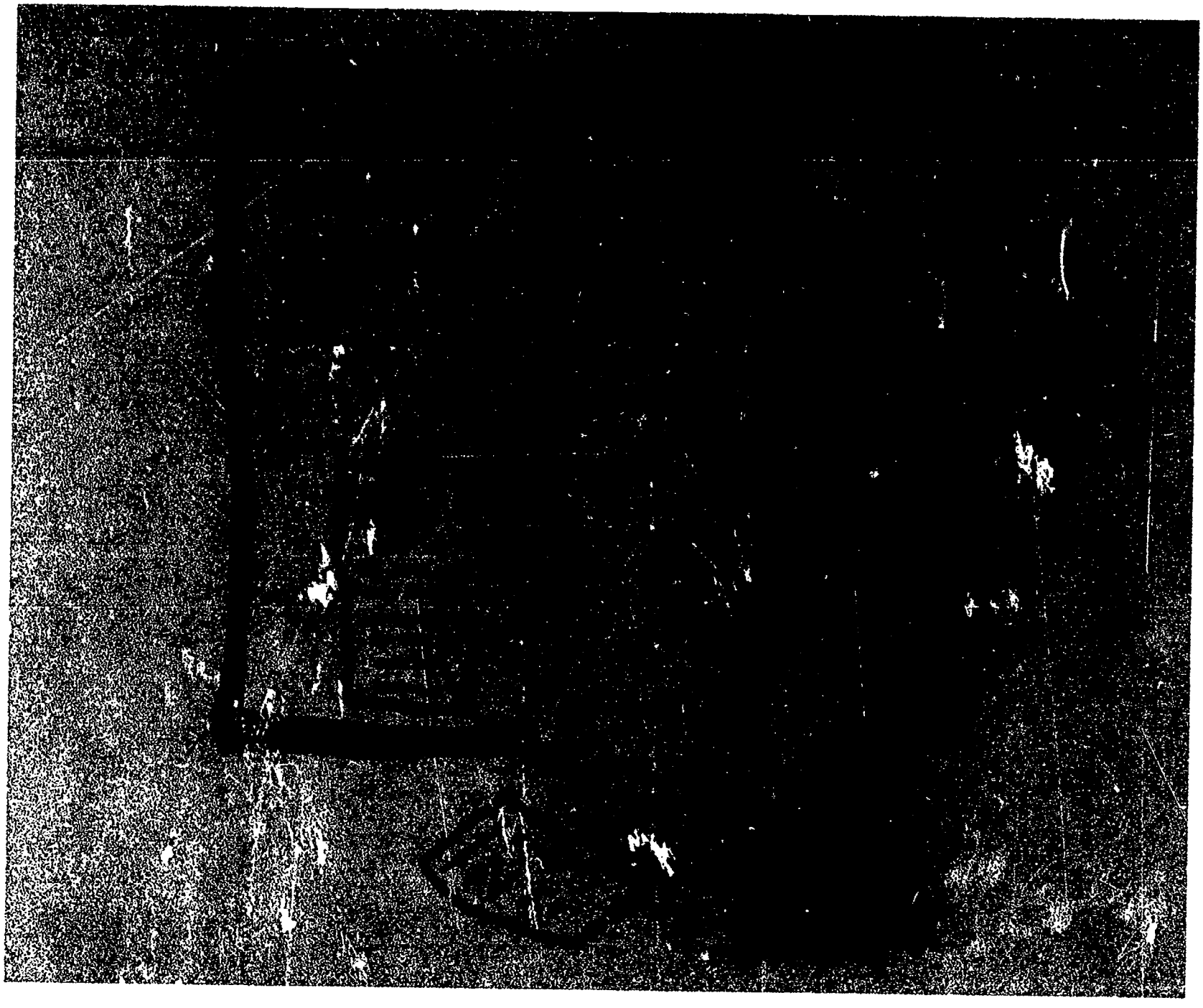
EDRS PRICE MF-$0.75 HC-$4.20 PLUS POSTAGE
DESCRIPTORS Conservation Education; *Curriculum Guides; Environment; *Environmental Education; Instructional Materials; Junior High School Students; Learning Activities; Natural Resources; *Sciences; *Secondary Education; *Secondary School Science; Teaching Guides
IDENTIFIERS Elementary Secondary Education Act Title III; ESEA Title III

ABSTRACT

This environmental education curriculum guide was developed for teacher use at the junior high school level. Although the guide deals with the bio-physical aspects of the environment, it is designed to encourage an integration of the disciplines into an inter-disciplinary approach. The volume consists of a set of ideas, activities, and opinions which will help teachers and students generate a positive approach to the environment. The guide is divided into the following six units: Earth Thoughts, which deals with value clarification; Quality of Life, which examines the quality of environmental components; Environmental Inventory, which presents methods for conducting an environmental inventory and analysis; Environmental Management, which identifies procedures used to monitor, control, and change the environment; Community Problems, which suggests steps for investigating community environmental problems; and Futurism, an activity oriented unit, which involves students in creative thinking and problem solving. Each unit contains an introduction, stating the purpose and background, instructional objectives, experiences, and references. The experiences of each unit are based on objectives which relate to the subject of the unit. Several activities, which reflect and reinforce the objective, are included in each experience. (TK)

Environmental Learning Experiences

Bio-Physical Junior High School

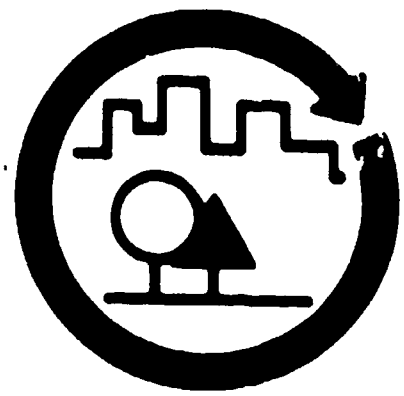


Prepared by
Center for the Development
of Environmental Curriculum
Willoughby-Eastlake City Schools
Willoughby, Ohio
Funded by an ESEA Title III grant
1974

Center for the Development of
Environmental Curriculum

Dennis M. Wint,
Director

Curriculum Specialists:
Mary R. Junglas
Laurence E. Pennell
Christine L. Shields
Stoyan N. Topalof
Susan M. Zacher



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INTRODUCTION

> Here is this vast, savage, howling mother of ours, Nature, lying all around, with such beauty, and such affection for her children, as the leopard; and yet we are so early weaned from her breast to society, to that culture which is exclusively an interaction of man on man - a sort of breeding in and in, which produces . . . a civilization destined to have a speedy limit.
>
> *Henry David Thoreau*
> (Bode, Carl (ed.), "Walking." Viking Portable Library, p. 621)

Environmental education is an integrated educational process which is only beginning to become a part of our educational institutions. What environmental studies there have been, have been relegated largely to science and elementary teachers, as ecology. The path of ecology (a word popular only since *Silent Spring*) is a noble one, but often unsuccessful in its attempts to create an environmental awareness that is vitally needed to turn our growing environmental dilemmas around. The environmental movement, if it can be called such, is already laced with comfortable cliches and a bumper sticker commerciality which is making hay while the spirit of Naderism rides high, as if taking advantage of a fleeting public fancy. Well-meaning environmental groups are experiencing financial and legislative setbacks, a result of an apathy fostered by ignorance, social-cultural pressures, and a mindless economy, spawned by the superficial concept of goodness in growth.

If environmental education is taken per se, we have been engaged in the process since our ancestral beginnings But within a very short space of time, the lessons of the environment have been lost, or fall on ears that can no longer hear. We have been steadily engaged in a flight from our real environment to an artificial one. This has been due to a faith in technology that has been blind, and demonstrated to be without limits or qualifications. This is one important reason why environmental education should be a total interdisciplinary approach which focuses upon the means of bringing us back in touch with the real environment. It should be an education which permits the experience of feeling ourselves as an intricate, inescapable part of the web of all life. We must recognize that we function within a delicate balance that requires a caring concern for life and gentle attitudes about the earth that will make us worthy stewards of the land.

Man is a part of the environment, as is the most insignificant form of life, and must derive his basic needs from the same tenuous flow of energy which sustains our entire ecosphere. He has adapted in accordance with the great constructors of change — the environment and heredity — and has met the rigors of survival to the point where his success has become dominion. He has engaged, through his superior intelligence, in an inexorable technocracy which has removed him beyond the realm of real contact with the web of life itself. For these reasons he has altered the environment more than any other living thing.

The significance of our life-ties to the earth has been diminished with the superficiality of plastic and throw-away cultures enraptured with mindless growth. Our tin can technology is in evidence even in mid-ocean. The limits seem to be at hand and a new philosophy, armed with meaningful understanding of the problems we face, is imperative.

It is important that those who have inherited our problems will be able to take a total world view of our deteriorating environment and be able to detect and sift through the obstacles that seem to shackle our present efforts because they will inherit the responsibility of providing solutions. Environmental education can not be approached from any one discipline but must draw upon the entire spectrum of man's ability to express his feelings and thoughts. Science is one means of perceiving and interpreting our environment but it is useless without confronting the political, social-economic aspects and empty without the richness of art, philosophy, poetry, and music which have spoken eloquently of man's relationship to the earth.

The Center for the Development of Environmental Curriculum has developed a set of volumes which gives the teacher an opportunity to draw from many disciplines in an effort to bring environmental education to our institutions through as many avenues of learning as possible. The CDEC curriculum volumes have been written by environmentalists and educators from as many areas of education as possible. Each unit may be utilized separately or in conjunction with other units. Although each volume represents a particular theme in a certain area and level (e.g. Earth Thoughs - Biophysical - Senior High), the entire curriculum is designed to encourage an integration of the disciplines into an inter-disciplinary approach. The volumes may be used also, as supplementary guides to activities in any area. It is hoped that the volumes can be viewed as a flexible set of ideas, activities, and opinions which will help teachers and students generate ideas and activities into meaningful educational experiences. They are resources which will enable those who use them to develop a way of thinking and feeling about nature, and it may provide the chance to help clarify our environmental values into sound models for action.

We are in the midst of environmental problems which leave us confused and frustrated in the maelstrom of pros and cons concerning our dilemma. That we are experiencing a steadily deteriorating environmental condition is beyond any doubt. The solutions are not easy. But if you have experienced the flow of water, fresh and cold over your body as it courses through some green mountain valley on its way to the sea, knelt in the cool, damp earth and clutched its rich smell to your face, or watched a Blue Heron in slow flight at sunset, you know it is worth saving. All the care, concern, and love for all life and its necessary place within the intimacys of our "tiny spaceship" is in those knowing moments. At those times we are in touch with the ages of all life's experience. Man is the only creature capable of contemplating his own death; only man can develop an environmental ethic that is futuristic and healing.

Ronald J. Yarian
Concerned Educator and Citizen

EARTH THOUGHTS

The purpose of this unit is to help students understand man's effect on the environment and the effect of the environment on man. The development of this understanding will be accomplished through a study of the attitudes of the students and others toward the environment. While scientific viewpoints should be emphasized, this study cannot overlook other viewpoints. Hopefully, through the understanding developed and through personal involvement in activities, the students will begin to promote a better life in the environment.

Value clarification and a study of the environment cannot be separated, for, in every way, what we value — as individuals, as a nation, and as a planet — is reflected in our environment. Because of the junior high school student's involvement in personal challenges, the type of study suggested in this unit is particularly appropriate, because it is centered around his attitudes, interests, and abilities, with the student making his own decisions and, to a great extent, guiding his own learning.

The teacher's role is to further challenge and guide the student through experiences which will help him discover his attitudes toward the environment, accept or modify those attitudes as he collects and examines the attitudes of others, and become involved in activities which reflect his values.

It is not the role of the teacher to force his values on the students. The seeming acceptance of another's values serves no real purpose; it is only through a personal understanding of one's own values and a commitment to them, that real learning and, hopefully, the betterment of life will occur.

This unit is written in three basic parts:

a. Expressing and collecting scientific attitudes about the environment
b. understanding man's effect on the environment and the effect of the environment on man, and
c. carrying out activities which reflect environmental values.

A variety of suggested activities is listed in each experience of the unit. The teacher should rely on the ones he feels are most appropriate to accomplish the stated purpose with his particular students.

Several of the activities suggested contain elements of risk and should be handled carefully by the teacher. When these activities are appropriate, the teacher should allow the students to originate the ideas or perhaps offer them as "possibilities" or suggestions rather than "assignments."

INSTRUCTIONAL OBJECTIVES:

1. The student will recognize his attitudes toward the environment.
2. The student will collect and examine the attitudes of others toward the environment.
3. The student will understand the interrelationships between man and the environment.
4. The student will become involved in environmental activities which reflect his values.

CONTRIBUTORS TO THE DEVELOPMENT OF THIS UNIT

Author ..... Sandra S. Huber
Editor ..... Mary R. Junglas
Revisor ..... Sarah A. Griffin

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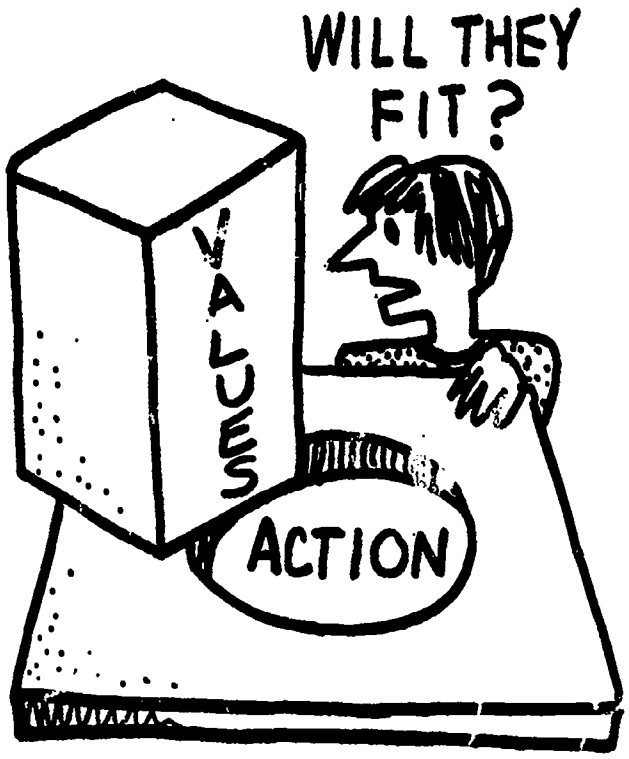
EXPERIENCE #1: STUDENT EXPRESSION OF ATTITUDES ABOUT HIS ENVIRONMENT

OBJECTIVES:

1. The student will develop an awareness of his environment.
2. The student will use free self-expression to express his attitudes toward the environment.



Teacher's Note:
Following are suggested methods to facilitate student sharing of collected attitudes when activities have been completed. A formal sharing session may or may not be important, depending on the involvement of the students.

1. *Begin a daily log which will be continued.*
2. *Participate in small group rap sessions. (The teacher should give directions about what the students are to discuss, keep groups small, and keep time periods brief enough so that time is called while conversations are still animated.) Reporting back to the large group may or may not be desirable.*
3. *Develop original creative plays.*
4. *Role play real or teacher-established situations. Actors assume or are assigned initial stances. They act out the situation in impromptu fashion. The teacher should direct the addition of characters as necessary, keep the play short, and initiate discussions at the conclusion. (Discussion questions could include these: How did the actor feel? What would the audience have done differently? Is this as it is in real life? What can be learned from this play?)*
5. *Draw or paint pictures.*
6. *Take photographs*
7. *Make movies*
8. *Collect pictures from magazines and various other sources to make a collage, poster, or bulletin board.*
9. *Collect objects and use them to make a collage.*
10. *Tape record attitudes.*
11. *Write poetry or free verse.*
12. *Make sculptures*
13. *Write essays*
14. *Write letters*
15. *Collect popular records or songs*
16. *Write attitudes on thought sheets regularly.*

ACTIVITY A:
Have each student select 10 words that he believes are representative of his environment. The teacher might guide this activity so that the student selects physical items such as trees, birds, animals; sensual items such as colors, smells, tastes; and/or abstractions such as truth, honesty, integrity.

ACTIVITY B:
Set aside one classroom wall for student inspirations. Ask each student to collect 10 to 15 pictures, objects, and/or magazine articles which describe his environment. Put them all together on a covered wall to form a giant collage, a poster, or a bulletin board.

ACTIVITY C:
Encourage the students to bring in popular recordings which are representative or descriptive of their environment.

a. Listen to the recordings.
b. Allow self-expression.

ACTIVITY D:
Ask the students to describe a person, street, or building familiar to all without using names or physical descriptions. They must consider what makes that person, place, or thing what it is. Other students guess what it is. (Example, an art museum, a busy street, a person littering, etc.)

ACTIVITY E:
Instruct the students to go outside and write about, draw, or take pictures of the places around them where they feel the most and the least comfortable. Encourage them to determine why those places make them comfortable or uncomfortable

ACTIVITY F:
Send students out-of-doors with tape recorders. Have them find sounds which they like and dislike and tape them. Later they should play these sounds for others and possibly try to explain why they find them to be pleasant or unpleasant.

ACTIVITY G:

Take the class on a walk around the community so that they can experience several opposites in their environment. Lists of opposites should be made by individuals or small groups before or after the walk, with minimal teacher assistance. Examples of opposites experienced might include noise and quiet, beauty and ugliness, light and dark, developed areas and open land, etc. (Polaroid cameras could be used or sketches made.)

ACTIVITY H:

Have students complete the following two statements:

1. The best things in our community are . . .
2. The worst things in our community are . . .

ACTIVITY I:

Use a value sheet to encourage individual reflection and possible value clarification on an issue that you think will be meaningful to the students. Two value sheets follow. They are merely included as samples. It is not expected that they will necessarily be on topics meaningful to your students. (Value sheets can be centered around quotations, pictures, cartoons, or experiences. Students respond voluntarily in writing. Their responses may or may not be used for later group discussion.) The best issues for value sheets arise out of daily situations and are very real to the students.

1. Value sheet centered around a paragraph. No group discussion of student responses is intended. Teacher comments should stimulate further student reflection.

Directions:
Please read the paragraph below and answer as many of the questions as possible. Answer the questions thoughtfully, honestly, and privately. I will collect the papers at the end of the period and return them to you tomorrow with occasional comments. This is an optional assignment and has no effect on your grade.

Many animals such as the passenger pigeon have become extinct — they will never again be seen alive. This extinction was caused largely by men who have over-hunted, poisoned water, used DDT, and abused nature in many other ways.

There are also many animals which remain alive in only very few numbers and are in danger of becoming extinct. Some of these are the American bald eagle, the whooping crane, and certain varieties of the tiger. Many environmentalists are adding man to the list of animals that are in danger of becoming extinct.

1. Is it important to you that some kinds of animals will never be seen alive? Why or why not?
2. What do you think about hunting for sport?
3. What could you do to keep an animal from becoming extinct?
4. How does the observation that man is in possible danger of becoming extinct make you feel?
5. Food supplies, war chemicals, and atomic reactions are some factors which might cause man's extinction. What can you do to keep man from becoming extinct?

2. Value sheet centered around a series of questions. A group discussion of selected anonymous responses is planned for a later date. The discussion should stimulate further student reflection.

Directions:
Please answer as many of the questions below as possible. Answer them privately, honestly, and thoughtfully. Some of the answers will be read anonymously to the class later for discussion purposes. This assignment will not affect your grade.

1. What five things that you own are the most important to you?
2. If you knew you were to be stranded alone on a deserted island for one month, what five things would you take with you?
3. Are the items you listed in answer to question 2 the same as the items you listed in question 1? Why or why not?
4. Are most of the things owned by you and your family basics to your survival or are they luxuries (not absolutely necessary for survival)?
5. Under what conditions would you be willing to give up many luxuries?

EXPERIENCE #2:
STUDENT COLLECTION OF THE ATTITUDES OF OTHERS

OBJECTIVE:
The student will examine the attitudes of others toward the environment and share his findings.

Teacher's Note:
Suggested methods to facilitate student sharing of collected attitudes. (A formal sharing session may or may not be important, depending on the involvement of the students.)

1. *Small group buzz sessions*
2. *Panel discussions*
3. *Symposiums in which various students deliver short speeches or reports on their collected information*
4. *Role-playing or role-reversal*
5. *Use of devil's advocate by the teacher —take the unpopular side of the issue to encourage discussion, thinking, and defense of positions*
6. *Collections of articles, pictures, photographs, and reports*
7. *Structured dramatizations (Find or write a play built around the theme that shows a lack of a sense of values or appreciations.)*
8. *Posters*
9. *Tape recordings*
10. *Collages*
11. *Oral reports*
12. *Written reports*
13. *Bulletin boards*
14. *Original cartoon strips*
15. *Creative radio and TV programs*
16. *Problem stories (newspaper articles)*

ACTIVITY A:
Listen to, read, look at, or experience the attitudes expressed by their classmates during activities suggested in Experience #1.

ACTIVITY B:
Prepare survey questions in advance and interview local people with a variety of personal interests, occupations and involvements. (Parents should not be overlooked.) Potential sources found in the yellow pages of the phone book include these:

1. Agricultural consultants
2. Fertilizer dealers
3. Paving contractors
4. Landscape architects
5. Automobile wreckers
6. Plumbers
7. Veterinarians
8. Foundry managers
9. Nurserymen
10. Government officials
11. Dairy products brokers
12. Insurance salespeople
13. Physicians
14. Residents of old-age homes

ACTIVITY C:
Contact various social service agencies, many of which provide free speakers, films, and literature. Examples from the Yellow Pages include these:

1. American Cancer Society
2. Family Service Association
3. Tuberculosis and Health Association
4. Hearing Society

ACTIVITY D:
Take a survey or use random sampling of students, teacher, or neighbors. (Random sampling is based on the theory that a survey of small area or population is representative and usually proportional to the larger area or population. The small area or population may be selected in a variety of ways. Although drawing names out of a hat would be completely random, in sampling large populations this is not feasible. Usually, therefore, in sampling a town, for example, certain areas representative of ages, economic levels, occupations, etc., of the townspeople are selected.)

ACTIVITY E:
View films, filmstrips, and TV programs expressing environmental attitudes.

ACTIVITY F:
Trace the history of the local area. Examine various ways man has looked at that ecosystem since settlement. Study wildlife changes, landscape changes, etc.

Guide students to list changes in the local environment that have occurred within their lifetimes, within another specified time period, or since a specified happening.

1. Determine how local adults view these changes. (Senior citizens could be excellent resources.)
2. Students should evaluate, individually, each change as "good," "bad," or "no opinion."
3. Is the environment realistic?

ACTIVITY G: TV SURVEY

Ask the students to watch one or more of their favorite TV programs to examine through critical thinking the relationships between the people in the program and their environment.

1. What are some of the relationships?
2. Are the characters realistic?
3. Is the environment realistic?

ACTIVITY H:

Study scientifically argued historical and current examples of "progress" which have altered or threatened to alter the environment.

Examples:

1. Construction of expressway through Shaker Lakes Park, Cleveland or local examples.
2. Dams and lock construction along the Ohio River
3. The creation of reservoirs
4. Clear cutting of forests
5. Extinction or threatened extinction of various animals
6. Housing developments
7. The development of man-made narrow canyons along city streets
8. The use and long half-life of DDT
9. Transportation via privately owned automobiles
10. Reclamation of land (San Francisco Bay, for example)
11. Damming of the Colorado River in the area of Glen Canyon and Grand Canyon National Park
12. The Miami jetport to have been located in the FloridaEverglades
13. Biological warfare

ACTIVITY I:

Read the statements and writings of current scientists, naturalists, conservationists, and thinkers made in regard to the state of the environment.

1. Consult periodicals found in libraries and homes. Examples:
   a. *National Parks and Conservation Magazine*
   b. *National Wildlife*
   c. *Ohio Woodlands*
   d. *American Forests*
   e. *Camping*
   f. *The American City*
2. Study attitudes of people currently speaking out on the environment.
   a. Ian McHarg
   b. Paul Erlich
   c. The Sierra Club
3. Review recently published books. Consult your library: new ones are available regularly.
4. Write for free literature.
   a. Department of the Interior
   b. National Park Service
   c. Research centers

ACTIVITY J:

Read literature recording the attitudes of scientists, naturalists, conservationists and philosophers from the past.

Examples:

1. John James Audubon
2. Charles Darwin
3. Henry David Thoreau
4. George Perkins Marsh
5. John Wesley Powell
6. John Muir
7. Gifford Pinshot
8. Rachel Carson
9. Aldo Leopold
10. Barry Commoner
11. Thomas Robert Malthus
12. Donella H. Meadows

ACTIVITY K:

Study the attitude of the countries of Norway, Denmark, and Luxembourg toward their environment.

EXPERIENCE #3: STUDENT EXAMINATION AND EVALUATION OF ATTITUDES

OBJECTIVE:

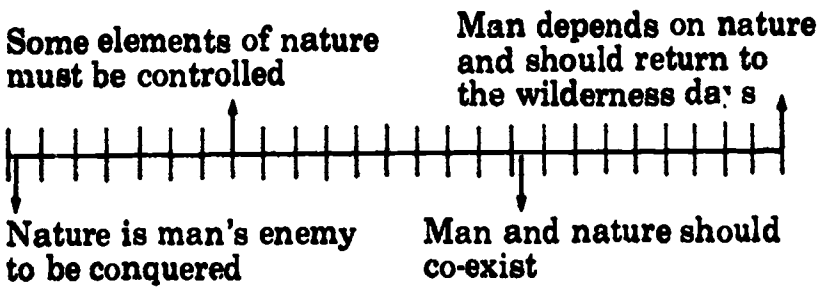
The student will be able to examine his attitude toward the environment and may re-evaluate his position later.

ACTIVITY A:

Ask the students to express their attitudes toward the environment at different times during the unit or at the end of their collection and examination of the attitudes of others. They could then compare the attitudes expressed at different times, noting likenesses, differences, and possible reasons for any changes in thinking. Employ a value continuum to aid student in identifying the position of different values in relationship to two extremes.

a. Identify values at the two extremes of a long line posted across the front of the classroom.

b. Have the students identify other known values and locate the positions of each between the two extremes.



ACTIVITY B:

Distribute value sheets to stimulate thinking and self-examination. (For example, see Activity I.)

ACTIVITY C:

Encourage tolerance of the points of view of others.

1. Pantomine love, hate, anger, friendliness. Make a note of the students' reactions and afterward have a discussion.
2. Through role playing.
   a. Have students assume roles not in agreement with their values.
   b. Establish situations; enact them.
   c. Examine feelings in roles (love, hate, anger, friendliness).
3. Pass out several cards on which different value statements are recorded. (The statements could be from the students' value sheets.) Ask the students to read the values expressed and record their reactions. Discuss.

ACTIVITY D:

Examine the differences between values possessed and values professed by planning a way to discover what people do that they say they do not do and what they do not do that they say they do. If possible, carry out the plan.

ACTIVITY E:

Filmstrips and films may be used also. Some commercial filmstrips or film provide open-ended pictured stories for helping children develop values, understandings and appreciations. These can help provide opportunities for children to learn how to solve problems through critical thinking.

EXPERIENCE #4: INVESTIGATION

OBJECTIVE:

The student will investigate man's effect on the environment and the effect of the environment on man.

Teacher's Note:

The main purpose of the activities suggested in this section is to promote a better understanding of the interrelationships between man and his environment. This might be pursued by the total class, small groups, pairs, individuals, or not at all.

ACTIVITY A:

Ask the students to list three plants and/or animals man relies on daily. Then direct the students to list as many of those plants' or animals' necessities for survival as possible.

ACTIVITY B:

Have the students summarize orally, pictorially, or in writing man's effect on the environment and/or the effect of the environment on man.

ACTIVITY C:

Divide participants into small groups. Assign each group a particular viewpoint of the interrelationships between man and the environment to be depicted through a collage, diorama, mural, or play. (The students will either already have an understanding of this viewpoint from the activities in Part I or they should use some of those activities to develop an understanding.) Examples of viewpoints follow:

1. Man has total control over his environment.
2. Earth is our mother; we must protect her. — American Indians
3. Man has no need for wild animals.

4. Man has no need for plants not grown for food purposes.
5. What happens to affect the environment of the United States affects only the environment of the United States.
6. Environmental problems can be solved only through worldwide action and control.
7. Water is free and in inexhaustible supply.
8. Overpopulation problems will be solved by food from the sea.
9. Smoke belching from factories indicates a progressive area.
10. Land used for housing developments, industry, and highways is and should be more valuable than farmland.
11. Man is the center of the universe and should conquer his enemy, nature.
12. The atmosphere and water are unlimited waste receptacles.

ACTIVITY D:

Send the students outside, individually or in pairs, to find two things. One of the things should be responsible for the other thing.

ACTIVITY E:

Evaluate student understanding by posing an ecological problem(s) and asking how man has affected the problem and how the problem has affected man.

1. Examples of problem areas follow:
   a. The war system
   b. Overpopulation
   c. Depletion of resources
   d. Multiple use of waterways.
2. Specific question: Can an animal today survive without man's consent?

ACTIVITY F:

Show the film, "Endless Chain". (See the bibliography for the name and address of distributor and a brief annotation.)

ACTIVITY G:

Have the students read any of the student books listed in the reference section.

ACTIVITY H:

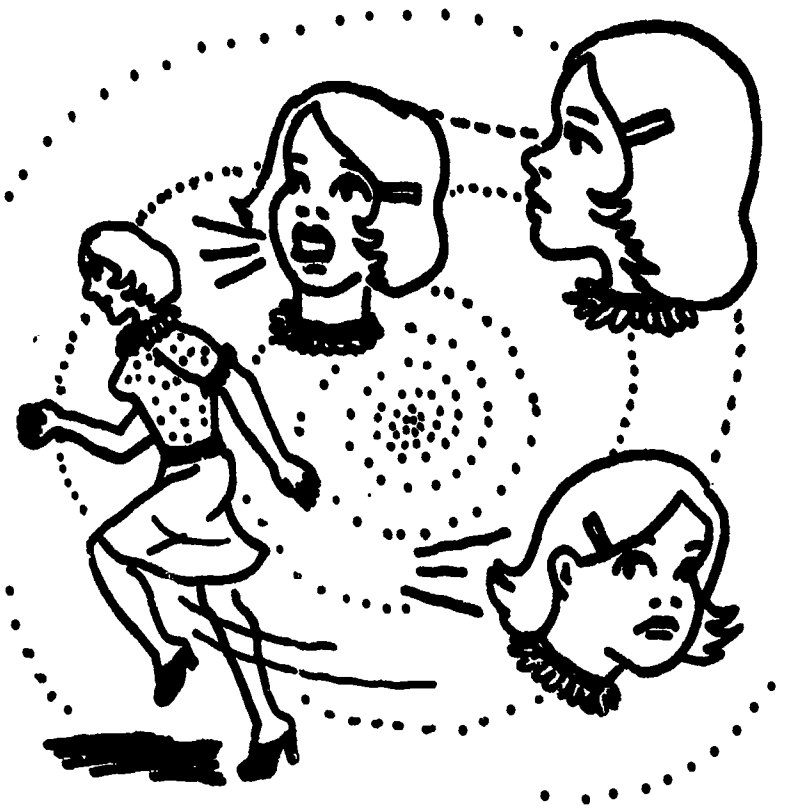
Introduce a controversial ecological problem and solicit student views which could be expressed through role playing or as personal opinions.

1. Raking leaves versus leaving them on the ground
2. Plowing yards and planting grass with fertilizer as opposed to having a natural lawn
3. Garbage pickup and rat control; city's shortage of funds
4. Tenant seeks apartment repainting; landlord uses lead paint
5. Total land clearing for agriculture versus leaving some thickets, woods and uncleared fence rows

EXPERIENCE #5: ACTION

OBJECTIVE:

The student will be able to perform activities which reflect his environmental values.



Teacher's Note:

Activities reflecting environmental values might perpetuate, reverse, or modify situations the student has noted in the environment.

When a student is seriously involved in this phase of the unit, it is probably important that he meet some degree of success in his endeavors. It is here that the teacher can be of great assistance in helping the student formulate a plan of action before becoming immersed in his project, which might be an alternative to scheduled class activities.

ACTIVITY A:

Investigate who is responsible for, and capable of, causing change in specific problem areas. List the problems, determine whether society as a whole, those involved only, or the individual can solve the problem.

1. Problem examples:
   a. Building of dams and reservoirs (numerous Ohio examples)
   b. Nuclear power plants
   c. Lake Erie jet port
   d. Use of fertilizers, pesticides, and/or herbicides
   e. Highway construction practices
   f. Housing developments
   g. Shortage of useable water
   h. Strip mining
   i. Threatened extinction of a particular animal

j. Life in and around a stream, river, lake or pond being changed or destroyed
k. Lumbering in state and national forests
l. Life and care of senior citizens
m. The increased population of some animals as a result of environmental changes. The brown rat, cowbird, and herring gull are examples.
n. The introduction of animals which have no natural enemies. Starlings and gypsy moths are American examples.
o. Increased pests due to monoculture.

2. Film examples (See the references for names and addresses of distributors and brief annotations.)
   a. "Glen Canyon"
   b. "The Gifts"
   c. "The Year of Disaster"
   d. "Oil Spoil"
   e. "Cycle"

ACTIVITY B:

Show the film, "Runaround." (See the references, for name and address of distributor and brief annotation.)

ACTIVITY C:

Examples of real activities which reflect environmental values:

1. Changes in an individual's life style (biking or walking instead of riding in a car, buying only returnable bottles, saving metal cans for recycling, eating health foods, etc.)
2. Campaigns of various types to influence others (Posters, letters writing, radio and television announcements, door-to-door visitations, etc.)
3. Manual or machine labor to change conditions or situations (Land reclamation, dishwashing by hand, lawn mowing without gasoline or electric power, mulching, composting, removing dams, etc.)
4. Informing the public with newsletters, posters, movies, open houses, etc.
5. Experimenting
   a. Cross-breeding
   b. Grafting
   c. Exposing growing plants to various conditions such as air pollution, different amounts of light, different temperatures, etc. (Be sure records are kept and a control is maintained.)
   d. Exposing various objects to different chemicals and/or conditions similar to those suggested above.
6. Writing letters
7. Working with government personnel. (Agricultural extension agents, personnel from the Environmental Protection Agency, local officials, etc.)
8. Constructing, planning, or developing equipment to change conditions or to aid in research projects.

ACTIVITY D:

Examples of Simulated Activities which Reflect Environmental Values:

1. Models and constructions with different media to portray problems, projected changes, etc. The models could be of communities, farms, industrial complexes, individual factories, buildings, fields, stream areas, etc. Suggested media:
   a. Sandboxes (whole cities could be built and modified)
   b. Plaster of Paris
   c. Clay
   d. Boxes in which to construct three dimensional scenes (dioramas)
   e. Wood
   f. Metal
   g. Paper
   h. Paper mache'
   i. Assorted odds and ends
2. Role playing situations

ACTIVITY E:

Examples of activities with living things which reflect environmental values. (See the references for sources of information on construction and uses.)

1. Aquariums
2. Terrariums
3. Microcosms

ACTIVITY F:

Examples of schematic activities which reflect environmental values. The student could describe a program for changing an existing situation, using pictures and/or drawings to illustrate his proposal and its consequences.

ACTIVITY G:

Show the film, "The Farm". (See the references for the distributor and a brief annotation.)

REFERENCES

Teacher Books

Falk, Richard A. *This Endangered Planet.* New York: Random House, 1971.

Harmin, M., H. Kirschenbaum, and S. B. Simon. *Clarifying Values Through Subject Matter.* Minneapolis: Winston Press, Inc., 1973.

Hoke, John. *Terrariums.* New York: Franklin Watts, Inc., 1972.

Mines, Samuel. *The Last of Mankind; Ecological Survival or Extinction.* New York: Simon and Schuster, 1971.

Nuffield Foundation. *Animals and Plants: A Sourcebook of Information and Ideas.* Great Britain: Wm. Collins, Sons and Co., Ltd., 1967.

Schwartz, George and Bernice. *Life in a Log.* Garden City, New York: Natural History Press, 1972.

Science Curriculum Improvement Study. *Ecosystems: Teacher's Guide.* Chicago: Rand McNally and Co., 1971.

Simon, Howe, and Kirschenbaum. *Values Clarification.* New York: Hart Publishing Co., Inc., 1972.

Snyder, Ernest E. *Please Stop Killing Me.* New York: Ballantine Books, Inc., 1971. Air and water pollution to show the effects on man and animals.

STUDENT BOOKS

Darling, Lois and Louis. *A Place in the Sun.* New York: Wm. Morrow and Co., 1968.

Ehrlich, Paul R. and Richard L. Harriman. *How to be a Survivor.* New York: Ballantine Books, Inc., 1971.

Ehrlich, Paul R. *The Population Bomb.* New York: Ballantine Books, Inc., 1971. The book deals with overpopulation of our society and how this will ultimately affect our living.

Leinwand, Gerald. *Air and Water Pollution.* New York: Washington Square Press, 1969.

Sears, Paul B. *Where There is Life.* New York: Dell Publishing Co., Inc., 1970.

FILMS

Cycles. 13½ minutes. Association-Sterling Films, 866 3rd Avenue, New York, N.Y. 10022. This film surveys the solid waste problem and suggests some remedies.

Endless Chain. 28 minutes. U.S. Atomic Energy Commission, Film Library — TIC, P.O. Box 62, Oak Ridge, Tennessee 37830. This film clearly and concisely explains that living is dying and that dying is living, but that unnatural elements such as man intercede and change the process.

The Farm. 28 minutes. Modern Talking Picture Service, Inc., 2323 New Hyde Park Road, New Hyde Park, N.Y. 10040. This beautiful film shows a farm devoted to both conventional crops and ecology. It shows many things being done to ensure the preservation of various animals.

The Gifts. 28 minutes. Modern Talking Picture Service, Inc., 2323 New Hyde Park Road, New Hyde Park, N.Y. 10040. Emphasizing water, this film shows how the United States has abused air, land and water. It was nominated for an Academy Award.

Glen Canyon. 26 minutes. Association-Sterling Films, 866 3rd Avenue, New York, N.Y. 10022. The first half of this film shows Glen Canyon and the Colorado River as it was before 1963 and the construction of dams. The last half shows the aftermath with trees submerged and animals drowned. It closes with a warning for citizens to block the construction of more dams along the Colorado River.

Oil Spoil. Association-Sterling Films, 866 3rd Avenue, New York, N.Y. 10022. This unnarrated film illustrates that the United States must either end its total involvement with the automobile or recognize the consequences and do something about them.

The Runaround. Available from the local Tuberculosis and Respiratory Disease Association. In animated color, this film depicts the story of a man who sees his house blackened and his health threatened. In an attempt to correct the problems he visits the factories. Each polluter sends him somewhere else to find answers to the problem of polluted air.

The Year of Disaster. 28 minutes. Modern Talking Picture Service, Inc., 2323 New Hyde Park Road, New Hyde Park, N.Y. 11040. Showing four American cities which almost ran out of water and the resource situation of each, this film illustrates that water is often taken for granted until it is almost too late.

TEACHER'S NOTES:

QUALITY OF LIFE

The purpose of this unit is to help students examine the components of their environment, to decide if the quality of those components is satisfactory, and to act to change the quality of those components if they so desire.

In the examination of the quality of life in their own community, the students will proceed from the general and very familiar to the specific and probably less familiar. In addition they will develop research techniques by moving from general observation to more difficult and rigorous investigation methods.

Although it may be desirable for all students to do all investigations in some instances, in most classrooms students should be given the freedom to choose the investigations and the research methods which are most interesting to them and which best suit their individual abilities. If a student prefers to design his own investigation, this freedom should be permitted, subject to teacher approval.

Student decisions about their satisfaction with the quality of life in their own environment involve inquiry and formation of value judgments. Values which are often unrecognized by the individual are the life guidelines which direct his behavior. The purpose of this unit is to direct inquiry and to help individuals to discover exactly what they do value.

In the past, teachers and other adults have tried to force their value systems upon the young. Research indicates, however, that although these imposed values may be accepted temporarily, they are rarely held permanently. Therefore, although the teacher should be honest in expressing his own values as such, he should not impose them upon the students.

Within established reasonable constraints relative to their own values, students should be allowed freedom of choice and action. Involvement in decisions about their own plans, their own actions, and the results of their actions is important because self-improvement helps to influence behavior and produce change. Therefore, the general suggestions for studying the community and producing change in the environment should not be considered arbitrary by the teacher. In this unit, the teacher should act as a guide, suggesting, helping. and encouraging the student as he makes his own decisions about his environment and how it should be changed.

INSTRUCTIONAL OBJECTIVES:

1. The student will acquire information by visual observation.
2. The student will classify relative facts.
3. The student will acquire information pertinent to a specific question through various research techniques.
4. The student will organize, evaluate, and define results of environmental problems within his own community.
5. The student will draw conclusions and form value judgments about the quality of life in his own community.
6. The student will make a commitment to a plan of action in order to improve the quality of life in his own community.

CONTRIBUTORS TO THE DEVELOPMENT OF THIS UNIT

Authors ..... Sandra S. Huber
Kenneth Norris, Jr.
Editor ..... Mary R. Junglas
Revisor ..... Ruth M. Spence

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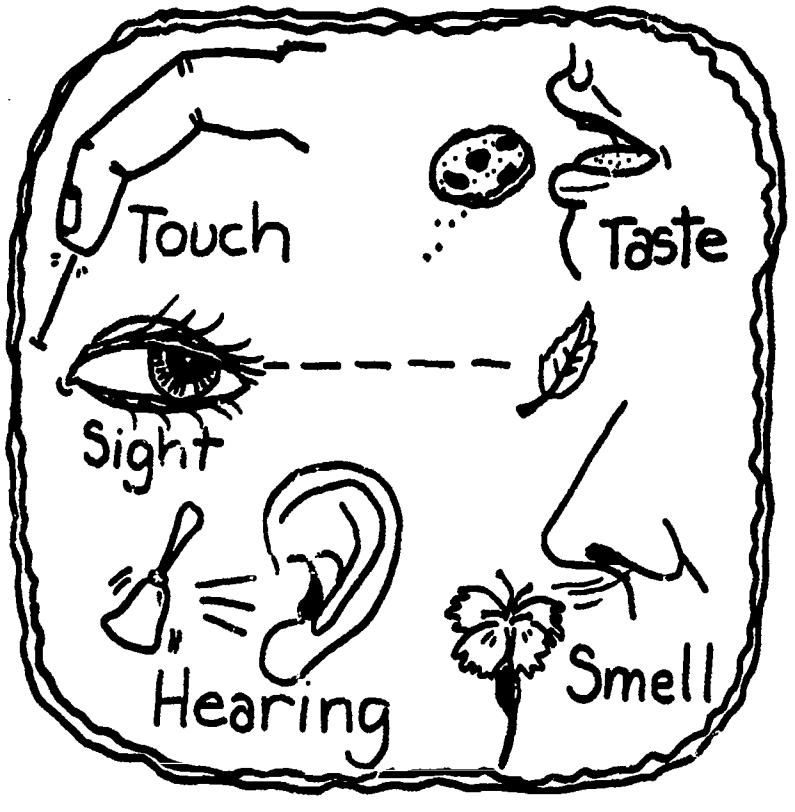


EXPERIENCE #1
GENERAL OBSERVATIONS

OBJECTIVES:

1. The student will develop sharpened powers of observation.
2. The student will understand systems of classification and realize their value.
3. The student will become aware of the components of his surroundings.
4. The student will discover his personal attitudes and/or value system as related to his environment.
5. The student will begin to accept the attitudes and values of others.

ACTIVITY A: NECESSITIES

1. Ask students to list in writing or on tape, all of the items they consider to be absolutely necessary for existence and continuance of life.
2. Collect the lists and read them anonymously. Discuss the lists. Encourage students to accept each other's viewpoints.

ACTIVITY B: IDEAL HOME

Teacher's Note:
This activity may be done in small groups or individually in class, or it may be given as a homework assignment.

1. Students should describe the kind of place which would be their idea of an ideal home. They should include details about structure, the area within and around it, sights, smells, sounds, and any other relevant information.
2. Students who have artistic ability might draw a plan or make sketches to go with the description.
3. If this activity is done individually, students could share ideas in small groups. If it is done in groups, group presentations to the class could be made.

ACTIVITY C:
CLASSROOM OBSERVATION

1. Students, individualls, should write down all the things in the classroom which they can observe. The teacher might guide students' thinking by making suggestions such as walls, location of windows, arrangement of seats.
2. Ask students to classify their observations. A sample classification chart is found below.
3. Students should discuss the need for classifications. Students should realize that various interpretations result from the same situations. Students should compare and contrast varying viewpoints.
4. Classification chart:

Item	Sight	Sound	Smell	Touch	(optional) Taste	Personal Response
wall	pale-yel. blocks	none	slightly sour	rough bumpy		innocuous dull
windows						
door						

5. The above chart might also include qualities of good and bad, size, shape, and use.

ACTIVITY D:
SCHOOL OBSERVATIONS

1. Have students, in small groups, walk around the school making and writing down observations about specific items. Each group may be assigned a category which includes certain kinds of items. Some categories are health and physical, safety, structural, intellectual, and administrative.
2. After the tour, students return to the classroom and classify their observations according to the above or a similar chart.
3. Some students might like to investigate questions whose answers are not immediately available, such as:
   a. What are the rules? Who makes them?
   b. Who decides what is served in the cafeteria?
   c. What color is the door to the principal's office?
   d. What unwritten rules does your school have?

ACTIVITY E:
COMMUNITY OBSERVATIONS

1. Ask students to make observations in their community either by small groups or individually.
2. Students should have a list of points to be observed: air pollution, bodies of water, transportation, recreation sites, plant life, animal life, kinds of homes, proximity of homes, and any other applicable items.

3. Students should bring their observations to class and in small groups or individually classify them according to some system.

ACTIVITY F:
COMMUNITY REPRESENTATIVE

1. Students may invite a councilman or other official to speak to the class. The person who makes arrangements for the speaker should inform him of what information the class will be seeking.
2. Students should listen to and take notes from the speaker on population growth, industrial growth, changes in educational and dwelling facilities, addition of kinds of businesses, changes in zoning, sewage disposal, solid waste disposal, transportation problems, noise pollution, energy usage, recreational facilities, housing problems, or any other topics which may be relevant to the particular community.
3. Students should follow up the speaker's ideas by rating the quality of items on a scale of 1 to 5. After rating all the items discussed, students make a judgment about the quality of the community.
4. Rating chart for quality of different items

Item	Poor 1	Needs Improvement 2	Fair 3	Good 4	Excellent 5
Air					
Recreational Facilities					
Sewage Disposal					

5. Students should compile results and discuss the general quality of their environment.

ACTIVITY G:
COMMUNITY INVENTORY

Teacher's Note:
When having the students do interviews, it is absolutely necessary to insist that they write down or tape record the comments made by the person they interview. Any attempt they make at just remembering will be faulty.

1. Students can survey community residents who are in specific occupations, asking them their opinions of the community.
2. Have the class make up a list of questions related to the topics which were discussed by the speaker.
3. Assign specific occupations to small groups for interviews: mailman, cab driver, milkman, editor of newspaper, bus driver or any other person who would be likely to have an overview of the whole community.
4. Students should report the results of the interview to the class.
5. The class then compiles the results of the interviews and compares these opinions to the rating chart which the class made.

ACTIVITY H:
FUTURE OBSERVATIONS

1. Have the class discuss how they might inform people of the future of what life was like in the 1970's by deciding what kinds of items might be placed in a time capsule. Both good and bad should be included.
2. The class can make up a time capsule and bury it.
3. Small groups or individuals can make up time capsules secretly, then exchange them with other groups or individuals so that they can judge how realistic and informative the items are.

ACTIVITY I:
SCAVENGER HUNT

1. Have students form small groups to go on a scavenger hunt for items which contribute to the quality of their environment. Each group should be provided with a list of things to look for in their environment.
2. The list below may be modified to suit the size and type of community where it is being used. In large city neighborhoods the area might be divided into sectors to be assigned to groups. Schools in rural areas might require the help of willing parents with automobiles.
3. List of items to be found on the scavenger hunt:
   a. Air pollution: contributors to air pollution; devices for control of air pollution.
   b. Water pollution: contributors to water pollution; types of control.
   c. Bodies of water; location; use; availability for public use.
   d. Sewage disposal: kind (i.ec. plant, septic tanks, dumping); location of plant, if any, and disposal of effluent.
   e. Transportation: kinds available
   f. Water: source of community water supply; adequacy; price if any; location
   g. Plant growth areas: locations, number, sizes
   h. Noise pollution: cause, general statement of how loud
   i. Recreational facilities and/or parks: locations, accessibility; quality and quantity of equipment; adequacy for population; usage rage; kinds of activities available; responsibility for upkeep.
   j. Housing facilities: different types of housing available; quality of housing available; price range for renting or buying; adequacy for population of area (over-crowding); spacing of homes (how close or far apart); zoning laws pertaining to housing.
   k. Specific spots of beauty, blight, ugliness, usefulness: state why beautiful, blighted, ugly, or useful.

l. Animal life: kind, amount.

m. Industrial areas or specific industries: kind, locations, contribution to improvement or marring of the communi y.

n. Social agencies: schools, old-age home hospitals, jails, court-houses; location, conditions of buildings, adequacy for population.

o. Own school: broken windows; unused books; locks; faculty meetings held; trees; places students may not go.

4. Have the groups bring their lists to class and report orally, then hand in the lists.
5. Members of the group with the most complete list should receive prizes.

ACTIVITY J: VALUES CONTINUUM

Teacher's Note:
A roll of shelf paper can be taped to the wall, and the students can use magic markers of different colors to show where their opinions lie on the continuum.

1. Students should state privately, in writing, their opinions about the overall general quality of the local environment.
2. Use the written statements to form a value continuum through class discussion. Statements should be anonymous. They may be dittoed so that each student will have a list and be able to interact with the class.

VALUES CONTINUUM:
QUALITY OF LOCAL LIFE

ACTIVITY K: SELF-INVESTIGATION

Teacher's Note:
In order for the student to get a clearer idea of what he values as a quality life, it may be helpful for him to take a closer look at himself. The privacy of a student's answer is important. He must feel he can answer honestly without fear of censure or riducule from his peers and even from his teacher. If a student expresses a desire to share some of his answers with the class, this may be a good basis for discussion.

Sentence stems to be completed privately in writing:
1. I hardly ever wonder . . .
2. What I'd like most to know is . . .
3. What bothers me the most is . . .
4. I really get a lot of pressure when I . . .
5. I'd like my friends to . . .
6. My idea of a good job is . . .
7. My idea of a good place to live is . . .
8. The thing I'd like people to admire me for is . . .

ACTIVITY L: PERSONAL INVESTIGATION

1. Try finding (in your community):
   a. something that looks like you
   b. something soft
   c. a relic of the past
   d. something scary
   e. a hiding place
   f. something free
   g. something rotten
   h. a place to sit
2. Find samples of opposites in your community.
   a. closed - open
   b. have - have not
   c. colorful - drab
   d. big - little
   e. loud - soft
3. What is being advertised in your community? Try to compile a list of all the billboards and outdoor advertising. What does this tell you about your community? About what other people think your community is like? What about graffiti?
4. What kinds of goods and the services are available in the stores within your community? Do the store owners live in or outside of your community?

ACTIVITY M: CELEBRATION

Arrange a celebration to honor the goods things in your life. In your investigations, you may have discovered many aspects of your community which please you. Share your discoveries in the form of a party or show.

Consider these things:
1. What you are celebrating
2. Costumes
3. When, where, and who
4. Methods of celebration

EXPERIENCE #2
PROBLEMS FOR INVESTIGATION

OBJECTIVES:

1. The student will gain some understanding and general knowledge about all the problems listed for investigation.
2. The student will relate the problems to their own community.

ACTIVITY A:
RECOGNIZING AND DEFINING PROBLEMS

1. The class will compile a list of problems which exist in their community. Their decisions about what kinds of problems exist will be based on their observations made in Experience #1.
2. The students will make suggestions about where they can find information about these problems as they exist in the nation generally.

ACTIVITY B:
GAINING GENERAL KNOWLEDGE

All students will do some research on each of the listed problems using one or more of the following methods.

a. Make a scrapbook of newspaper articles about the problems.
b. Read and summarize magazine articles about the problems. A guide sheet to fill in would help students to focus on the exact information the article is giving (See Appendix B)
c. Listen to speakers on the problems.
d. See films about the problems (See the bibliography).
e. Interview specialists about the problems.
f. Read books about the problems (See the bibliography).
g. Have the teacher present the material.

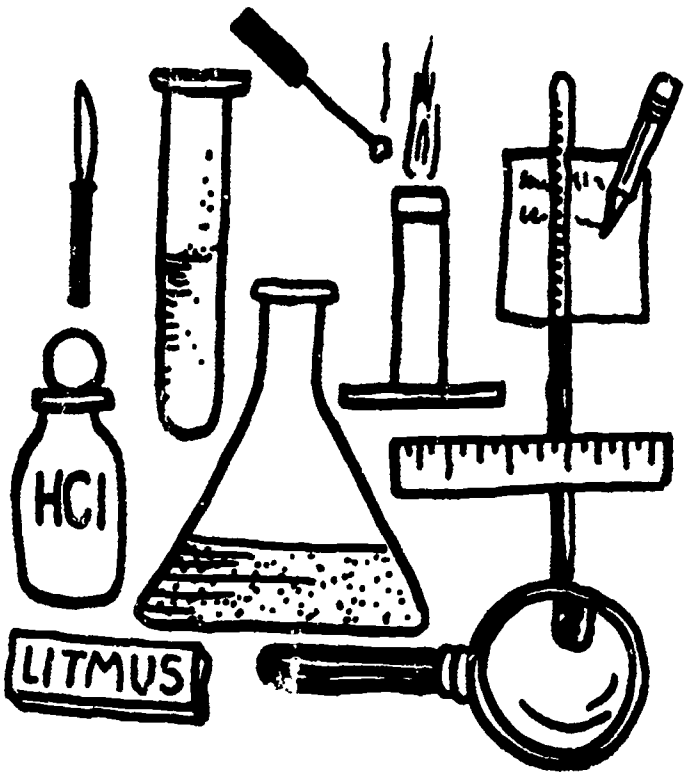
Materials:
Newspapers, magazines, paperback books, films

EXPERIENCE #3
INVESTIGATION OF A PROBLEM IN THE COMMUNITY

OBJECTIVES:

1. The student will focus his attention on one environmental problem which exists in his community.
2. The student will carry out several activities in order to learn more about the problem.
3. The student will assess the level of the problem as it exists in his community.
4. The student will investigate all areas of one problem in his community.
5. The student will make value judgments about the quality of life in his chosen investigation area.

Teacher's Note:
At this point the students should choose a problem from the list compiled by the class. The investigation may be carried on individually or by small groups. The activities which are listed for the problems presented here should be considered as suggestions. The students may wish to choose from these lists or make up some learning activities of their own. At the end of his investigation, each student should fill out an investigation report sheet, such as the sample in Appendix A.



ACTIVITY A: AIR QUALITY

1. Interview a specialist from an environmental organization to find out how pollution counts are made. Ask also about the quality of air in the community.
2. Evaluation of level of air pollution
   a. Select sites to place large pieces of cloth: school roof, school yard, own yard, classroom, house.
   b. Anchor the cloths tightly to something stable.
   c. At the end of a specified period of time, compare all the cloths and decide which location has the poorest quality of air and why.
   d. Display the cloths and the results.
3. Testing the Air
   a. Smear a glass slide or plate with a light coating of oil or petroleum jelly. Set the plate at a selected location for at least 24 hours. Repeat this process with a new slide for a week.
   b. Compare amounts of particulates collected for each day of the week.
   c. Try to discover what day or days have a higher particle count than others. Take into consideration traffic patterns and industry.
4. Description of the Quality of the Air
   a. Describe the results of the above tests.
   b. Compare the quality of air in the community to that of other communities. Consult newspapers or listen to radio reports for this information.
   c. State the conditions that effect the quality of the air.
   d. List things that might be done to change the quality of the air.
5. In-depth Research
   a. Do some research on official information about air quality by consulting regional pollution control agencies or local environmental groups.
   b. Fill in the following sheet about air pollution control agencies.
   c. Present findings to the mayor, council, or to the public by writing letters to the individuals or to the editor of a local newspaper.

ACTIVITY B: WATER QUALITY

1. Investigating Bodies of Water
   a. Select and plot water systems to be investigated. (Natural lakes, ponds, rivers)
   b. Observe the shoreline of the body of water looking for such things as dead organisms, rocks, litter (cans, bottles, paper), moss, algae, white foam and signs of erosion. Record the observations.
   c. Check for distinctive odors. Record and describe the odors.
   d. Determine the origin and end of a body of water.
   e. Chart all locations of in-flow streams Find out if these streams bring pollutants into the main body of water.
   f. Using sieves, scoop water from its source and collect all particles (dead, alive, animal, plant, or trash). Record the size of sieves used and describe/count each particle trapped in each sieve.
   g. Determine the use of water systems investigated.
   h. Take water samples back to class for laboratory analysis, if possible.
2. Authority
   Consult an authority on water pollution and fill in the same type of sheet that was used for air pollution.

ACTIVITY C: FORESTS, WOODLANDS, AND MEADOWS

1. *Plotting*
   Plot out the locations of forests, woodlands, parks, or meadows in the community.
2. *References*
   Use references to determine the traits that should be possessed by the kinds of systems in existence.
3. *Investigating*
   a. Rope off 100 square meters of the ecosystem chosen for investigation.
   b. Record temperature, moisture, light.
   c. Identify various plants and animals within the chosen area.
   d. Compare findings with the reference traits and note discrepancies.
   e. Decide if the findings should be as they are for the community.
4. *Inform Public*
   Write a letter to the editor of a local paper about any "eyesores" where junk is collected and kept in the community. In the letter, request that the public do something to cleanup the area.
5. *Ad Collection*
   Make a collection of advertisements in magazines that are related to recycling. Many companies are now using this topic as a basis for their ads. Put together a bulletin board or a scrapbook of these ads.

ACTIVITY D: LANDSCAPING

1. *Survey of Community*
   a. Do a survey to assess the attitude of the community about lawn care, shrubs, flowers, etc.
   b. Compile the results of the survey to see what the general attitude is.
2. *Observation Tour*
   a. Tour the community to determine what actually exists in relation to lawn care, shrubs, flowers.

AIR POLLUTION STUDY SHEET

1. Name and jurisdiction of regional air pollution control agency

_____

_____

2. Who selects the directors and staff?

_____

_____

3. What activities do they carry on to regulate air pollution control?

_____

_____

_____

4. What power does the agency have to limit emissions of pollutants?
   a. from industries _____
   b. from automobiles _____
   c. from residences _____

5. What power does the agency have to prosecute violators of regulations?

_____

6. Annual Budget _____

7.

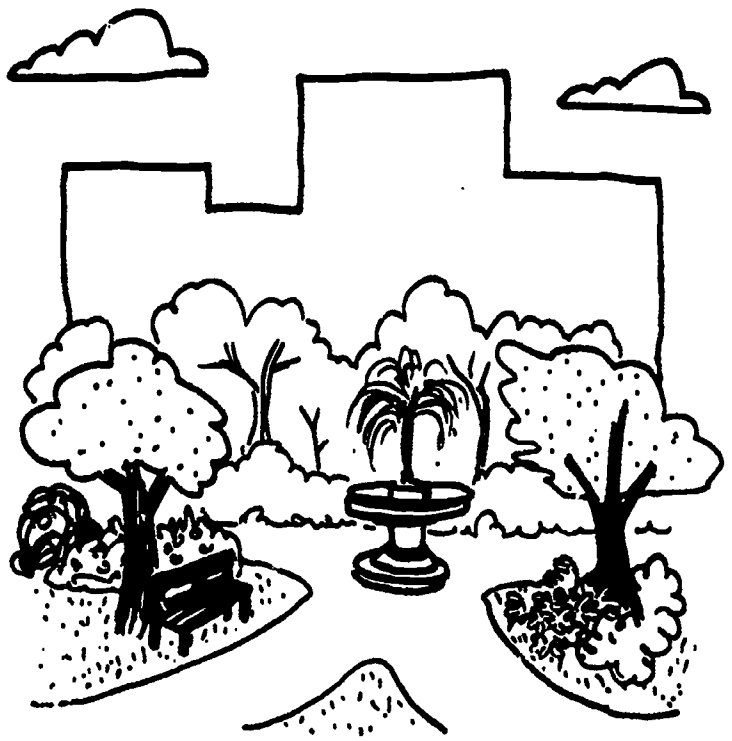
Type of pollutant	Density of each pollutant, in ppm: Your Neighborhood	Other Neighborhood	Other Neighborhood
Carbon monoxide			
Oxides of nitrogen			
Organics			
Sulphur oxides			
Particulates			

8. In a year, how many violations of pollution standards were noted by the air pollution control agency? _____

9. How many violations were prosecuted in the courts? _____

10. How many prosecutions ended in convictions? _____

11. Total fines paid _____



b. Compare the results of the survey to the results of observing what actually exists, and decide if the community is doing what it says it wants about this topic.

3. *Comparison*
Take a trip to nearby communities to see what they have done about planting and landscaping.

4. *School Landscaping*
   a. Examine the school and decide whether any improvement might be made in landscaping of the school grounds.
   b. If improvement is needed, contact the principal about funds for plantings that would add to the school environment.
   c. Receive permission to plant trees, shrubs, or flowers on the school grounds and do so.

5. *Community Landscaping*
   a. Contact the mayor or council about parts of the town which might be improved by landscaping. Ask for funds to be allocated to buy plants.
   b. Volunteer to plant some section of the community with trees, shrubs and flowers provided by the funds.

ACTIVITY E: SEWAGE DISPOSAL

1. *Field Trip*
   a. Visit the local sewage disposal plant or waste water treatment plant.
   b. Obtain samples of water as it goes through and comes out of the plant.
   c. Interview the manager of the plant to find out about the plant's capacity, whether it is adequate for the community, what kind of treatment is given (primary, secondary or tertiary) and where the effluent is released.

2. *Testing Samples*
   a. Obtain a water testing kit from a company or use materials in the laboratory.
   b. Test the water samples from the waste water treatment plant.
   c. Obtain a sample of the water from the body of water into which the effluent from the plant is released. Test this water. Compare the results.

3. *Action*
   a. Interview the mayor or councilman about the plans for improvement of water treatment facilities as the population grows.
   b. If results of the water testing show undesirable elements in the water, inform the mayor and council and the public by letters to the editor of the local newspaper.
   c. If the water tests show a favorable result, write a letter to the editor of the local paper complimenting the mayor and council about it.

ACTIVITY F: NOISE

1. *Learning About Noise*
   a. Using a sound meter, find out how loud hearing level is and how loud a dangerous level of noise is.
   b. Look up information about what decibels above 140 can do to people's ears.

2. *Noise in the School*
   a. Using a sound meter check the noise levels in different areas and during different activities in school: cafeteria, gymnasium, during a school dance.
   b. Record results and draw conclusions about the level of noise in the school. Is there any time that the noise level comes close to the dangerous level?

3. *Community Noise*
   a. Go out into different areas of the community with a sound meter: airport, traffic area, dragstrip. Check the sound levels in these areas.
   b. Record the results and draw conclusions about the levels of noise at these areas.

4. *Survey*
   a. Visit a local airport and listen to the sounds of jet planes in the area.
   b. Make a survey of the neighborhood surrounding the airport to find out about reactions of people who live near the airport to the sounds. (Students should have survey questions made up and checked before they go out to talk to people.)

5. *Interview*
Interview an administrator of a local airport to find out what is being done to lower the noise level of jet planes or to avoid bothering the community near the airport.

6. *Action*
   a. Draw conclusions from the investigations of noise level by answering the following questions.

      (1)At what level is the sound in each area tested?

(2) How many people are affected by this noise?
(3) What is being done to help rid the area of this noise?

b. Publish the findings by writing a letter to the editor of the local paper.

ACTIVITY G: TRANSPORTATION

1. *Observation and Investigation*
   a. List all the different methods available for transportation in the community.
   b. Consult public records to learn if public transportation systems are adequate for the population of the community.
2. *Interview*
   Interview several adults to learn what method of transportation to and from work they prefer.
3. *Parking*
   Tally parking facilities and determine whether they are adequate.
4. *Public Transportation System Use*
   a. Contact the public relations department of the local public transportation system to find out how many people use the system daily.
   b. Determine what percentage of the total population is using the system.
5. *Internal Combustion Engine*
   a. Look up information about the internal combustion engine and how it works.
   b. Draw conclusions about effect automobiles have on the environment.
6. *Modern Methods of Transportation*
   a. Find and read several articles about new public transportation systems which are being built in different areas.
   b. Using some ideas from these articles, "invent" a public transportation system which would effectively cut down on the amount of traffic caused by commuters and which would cut down on air pollution.
   c. Draw plans or make a model of the invention.

ACTIVITY H: ENERGY

1. *Articles*
   a. Find articles in magazines which tell about new forms of energy which are being considered.
   b. Read the articles and make a list of the pros and cons for each one.
2. *Energy Conservation Activities*
   a. Check on different ways of saving fuel, such as turning down the thermostat, taking part in car pools, turning out electric lights, walking or riding bicycles instead of asking parents for rides, or unplugging solid state radios and TV sets when they are not in use.
   b. Interview parents to find out if they are doing or are interested in doing these things.
   c. Take a poll among students to find out if any of them are doing these things. Compile the results of the poll.
3. *Interview Authority*
   a. Interview a representative of the local electric company to find out how many killowatts of electricity are used each month and how many the average family uses.
   b. Write a letter to the editor of a local paper, stating these facts and including information about how individuals can save electricity.

ACTIVITY I: BLIGHT

1. What happens to old vehicles in your community? Are they abandoned? Are there unsightly junkyards?
2. Are there old buildings in your community that should be razed? What procedures must be followed in order to have them razed?
3. What legal recourse does a community member have to combat blight?
4. What are the effects of blight on your quality of life?

ACTIVITY J: LIFE STYLES OF THE POPULATION

Job Earning Activities

a. What are the wage earning activities of the population?
b. How do these activities relate to the quality of the physical environment?
c. How is the migration of the population related to:
   (1) job stability
   (2) property pride
   (3) community pride
   (4) local government

ACTIVITY K: SYNTHETICS

1. Set up a display of assorted articles. Allow the students to examine them freely.
2. Discuss the properties of each article.
3. Determine definitions of "synthetic" and "natural."
4. Classify articles as either synthetic or natural materials. (Student research may be necessary.)
5. Discuss the values of synthetic and natural materials and how they relate to the overall quality of life. Encourage the acceptance of different viewpoints.
   a. What natural materials are "better" than synthetics?
   b. What synthetics are "better" than natural materials?
   c. What is meant by "better"?
6. Send pupils out to collect natural and synthetic materials.
   a. Tape record sounds.
   b. Photograph examples.

c. Draw examples
d. Make rubbings to compare textures of natural and synthetic materials. (real brick and fake brick, for example).

7. Share results; discuss.
8. Try producing synthetics in the classroom.

ACTIVITY L: TIME

1. Keep track of how you spend your time, twenty-four hours a day for one week.
2. Classify activities. For example: school, study, eating, sleeping, leisure, etc.
3. Graph or chart results.
4. Discuss the results:
   a. How does the way you spend your time reflect your quality of life?
   b. How might changes in your use of time change your quality of life?

EXPERIENCE #4
ORGANIZING DRAWING CONCLUSIONS, SHARING

OBJECTIVES:

1. Students will organize the information gathered.
2. Students will draw conclusions about the problem, basing their ideas on the information gathered.
3. Students will present the material to classmates.
4. Students will form concepts about each other's investigations.

ACTIVITY A: ORGANIZATION

1. Each student or group will organize the material according to the kind of presentation they wish to make.
2. Students will plan a presentation of their information to the class.
3. Some suggestions for presentation plans are these:
   a. Skits
   b. Role playing
   c. Debate
   d. Video-tape show
   e. Interviews held in front of class
   f. Overhead projector
   g. Tape recording
   h. Drawings with oral explanation
   i. Photographs/slide show
   j. Panel discussion
4. The presentation should include an explanation of the problem, cause of the problem, all information relevant to the problem, explanation of the action taken or to be taken, conclusions drawn as a result of the investigation.

ACTIVITY B: PRESENTATION

Students give their presentation to the class.

ACTIVITY C:
LISTENING TO OR
WATCHING PRESENTATIONS

1. Students should listen to each other's presentations.
2. Students should write a brief evaluation of the presentations anonymously. These should be handed to the teacher to be given to the students making the presentation later.
3. At the end of each presentation, the students write a specific statement of reaction to the problem.

EXPERIENCE #5
FOLLOW-UP

OBJECTIVES:

1. The students will seriously consider their own life styles.
2. The students will evaluate their life styles in relation to the problems that have been investigated and the environment in general.
3. The students will make some change in life-style as a result of the consideration of problems.

ACTIVITY A: DISCUSSION OF LIFE STYLES

1. Have small groups or the class discuss personal habits which might affect the government and the community's over-all quality of life. Some examples might include the use of throw-away bottles and cans, littering, reliance upon private automobiles, overuse of water, intake of "junk" foods, acceptance of paper bags for one or two purchased items or over-use of energy.
2. Students should be encouraged to select one of the styles of life discussed which belongs to them and to attempt to change that particular lifestyle for a definite period of time, one or two weeks for example.

ACTIVITY B: LOG

1. During the designated period of time, each student should keep a daily log of his activities involving the experimental change of habits. Special emphasis should be placed on recording how he feels about what he is doing.
2. At the end of the established time period, the experiment should be evaluated, perhaps in small groups of students who are involved in like experiments.
3. Students answer the following questions about the experiment:
   a. What was each person's over-all feeling about the experiment?
   b. Would the permanent acceptance of that life style by himself/herself and/or by a large number of people result in a change in the quality of life?
   c. If so, how might others be encouraged to make the change?
   (A resulting plan of action might be pursued.)

ACTIVITY C: ROLE PLAYING

1. Have individual students assume roles in opposition to their beliefs on a controversial topic related to the quality of life and enact a discussion in front of a group. (Sample topics: the value of synthetic materials over natural materials; the use of all available resources as opposed to limited use, etc.) The more timely and interesting the topic, the better will be the enactment.
2. The teacher should set the stage, introduce new roles as necessary, conclude the enactment when it is still lively and animated, and pose questions such as the following for group discussion:
   (1) How did each actor feel?
   (2) Did the actor begin to believe the role he was playing?
   (3) What would the audience have done differently?
   (4) Was this enactment similar to real life?
   (5) What can be learned from this play?
3. Repeat as desired.

APPENDIX A:
INVESTIGATION RECORD SHEET

INVESTIGATION SHEET

Name _____

Problem Investigated _____

List all the activities you completed in order to carry out the investigation.

_____

_____

_____

List all the material you read as part of your investigation.
Give complete bibliographic information about them.

Books _____

Magazine and Newspaper Articles _____

List the names and positions of anyone you interviewed as part of your investigation.

_____

Make a statement about the problem as it exists in your community.

_____

State any action that is being taken to solve the problem and tell who is taking that action.

_____

State your opinion of the problem and tell what you think the cause of it is.

_____

State what effect the problem has on the community.
Tell what you think the result will be if the problem is not solved.

_____

_____

APPENDIX B:
GUIDESHEET FOR PERIODICALS

Guidesheet for Summarizing Magazine Articles

Name of author of article _____

Title of article _____

Name of Magazine _____

Volume _____ Date _____

Problem the article deals with _____

Effects of the problem _____

_____

What does the article say is the cause of the problem? _____

_____

_____

What does the article say will be the result of the effects of this problem if it is not solved? _____

_____

_____

Personal reaction (Agree or disagree with the main idea the article presents. Give reasons for your opinion.)

_____

_____

_____

What means of solving or eliminating the problem does the article mention? _____

_____

_____

REFERENCES

TEACHER BOOKS

Andrews, William A. (Editor). *Environmental Pollution*. Englewood Cliffs: Prentice-Hall, Inc., 1972.

Falk, Richard A. *This Endangered Planet*. New York: Random House, 1971.

Harmin, M., H. Kirschenbaum, and S. B. Simon. *Clarifying Values Through Subject Matter*. Minneapolis: Winston Press, Inc., 1973.

National Tuberculosis and Respiratory Disease Association. *Air Pollution Primer*. New York: National Tuberculosis and Respiratory Disease Association, 1969.

Science Curriculum Improvement Study. *Ecosystems: Teacher's Guide*. Chicago: Rand McNally and Co., 1971.

Simon, S. B., H. Howe, and H. Kirschenbaum. *Values Clarification*. New York: Hart Publishing, 1972.

U.S.D.A. *Environmental Planning and Geology*. Washington: 1969.

Warren, Roland L. *Studying Your Community*. New York: Free Press, 1955.

STUDENT BOOKS

Carson, Rachel. *Silent Spring*. Greenwich, Connecticut: Fawcett Publications, Inc., 1962.

DeBell, Garrett. *The Environmental Handbook*. New York: Ballatine Books, Inc., 1970.

Ehrlich, Paul R. *The Population Bomb*. N. v York: Ballantine Books, Inc., 1971.

Ehrlich, Paul R. and Richard L. Harriman. *How to Be a Survivor*. New York: Ballantine Books, Inc., 1971.

Goodykoontz, W. F. and S. S. Brewer. (Editors). *Environment: Earth in Crisis*. New York: Scholastic Book Services, 1973.

Graham, Frank Jr. *Since Silent Spring*. Greenwhich, Connecticut: Fawcett Publications, Inc., 1970.

Jones, Claire, Steve J. Godler, and Paul H. Engstrom. *Pollution: The Food We Eat*. Minneapolis, Minnesota: Lerner Publications, Inc., 1972.

Jones, Claire, et al. *Pollution: The Air We Breathe*. Minneapolis, Minnesota: Lerner Productions, 1972.

Jones, Claire, et al. *Pollution: The Waters of the Earth*. Minneapolis, Minnesota: Lerner Publications, 1971.

Leinwand, Gerald. (Editor). *Air and Water Pollution*. New York: Washington Square Press, 1969.

Leinwald, Gerald. *The City as a Community*. New York: Pocket Books, 1970.

Sears, Paul B. *Where There is Life: An Introduction to Ecology*. New York: Dell Publishing Co., 1970.

Snyder, Ernest E. *Please Stop Killing Me!* New York: New American Library, 1971.

STORY

Bradbury, Ray. *"A Sound of Thunder." Eco-Fiction*. John Stadler (Editor). New York: Washington Square Press, 1971.

PERIODICALS

Last Whole Earth Catalogue, Portola Institute, Inc., Random House of Canada, 1971.

Lifestyle, P.O. Box 2300, Hendersonville, North Carolina 28739.

Mother *Earth News*, P.O. Box 38, Madison, Ohio.

Smithsonian, Smithsonian Institute, Washington, D.C.

PAMPHLET

Seventy-One Things You Cn Do to Stop Pollution, Keep America Beautiful, Inc., 99 Park Avenue, New York, N.Y. 19916.

FILMS

Cycles. Association-Sterling Films, 866 3rd Avenue, New York, N.Y. 10022. Surveys the solid waste problem and suggests remedies for it. 13½ minutes.

Endless Chain. U.S. Atomic Energy Commission Film Library, TIC, P.O. Box 62, Oak Ridge, Tennessee 37830. Shows that man's intercession in the life process changes it. 28 minutes.

The Farm. Modern Talking Picture Service, Inc., 2323 New Hyde Park Road, New Hyde Park, N.Y. 10040. Shows a farm devoted to both conventional crops and ecology. Demonstrates many things being done to ensure the preservation of various animals. 28 minutes.

The Gifts. Modern Talking Picture Service, Inc., 2323 New Hyde Parks Road, New Hyde Park, N.Y. 10040.

Oil Spoil. Association-Sterling Films, 866 3rd Avenue, New York, N.Y. 10022. An unnarrated film which illustrates that the United States must either end its total involvement with the automobile or recognize the consequences and do something about them.

The Runaround. Local Tuberculosis and Respiratory Disease Association. Depicts the story of a man who sees his house blackened and his health threatened by air pollution.

The Year of Disaster. Modern Talking Picture Service, Inc., 2323 New hyde Park Road, New Hydge Park, N.Y. 11040. Shows four American cities which amost ran out of water and the resource situation of each. Illustrates that water is often tkaen for granted until it is almost too late.

ENVIRONMENTAL INVENTORY

During the early years of the environmental movement, citizens and government officials were without sufficient data to deal with recognized problems. This dilemma was caused in part by the lack of attention in gathering information, as well as the processes that were involved. The emotional fervor has since passed and has been replaced by scientifically founded knowledge.

This unit is concerned with methods of collecting and analysing data about the bio-physical universe. In order for one to be more responsible in his understanding of the environment, it is desirable for him to develop skills of data collection and analysis which can only be accomplished by direct experience with the environment. He should strive to become an active environmentalist, not an arm-chair environmentalist, if he wishes to become effective. In the process, one learns to respect the environment and the factors that affect it.

Each student is an individual, the product of heredity and environment, and each has an individual perspective of the environment. This unit will give students the opportunity to pursue their own interests, within the constraints of time, equipment, and ability.

In addition to developing skills through self-involvement, the student will clarify values and develop the ability to inquire, research, discuss, and interact with his peers and superiors in an intellectual fashion.

This unit will aid the teacher in becoming more effective as a motivator, a facilitator, and an educational resource. It is hoped that he will become more enthusiastic and energetic as a result.

INSTRUCTIONAL OBJECTIVES

1. The student will gain knowledge of the interdependence within the environment.
2. The student will experience initiating, planning, and carrying out inventories of natural and man-made communities.
3. The student will gain experience in finding and using literary and community resources.
4. The student will recognize ways to evaluate existing conditions and form judgements concerning those conditions.

CONTRIBUTORS TO THE DEVELOPMENT OF THIS UNIT

Authors ..... Bonnie Naglich
Jack Arnold
Editor ..... Mary R. Junglas
Revisor ..... Kenneth Norris, Jr.

TABLE OF CONTENTS

EXPERIENCE #1:
INTRODUCTORY EXPERIENCE IN INVENTORY TECHNIQUES

OBJECTIVE:

The student will gain an understanding of, and become knowledgable about, an inventory process.

Teacher's Note:

This entire experience is designed to define what an inventory is, the value of an inventory, and the logistics involved in executing an inventory.

ACTIVITY A: INTRODUCTION TO THE INVENTORY PROCESS

1. Have students relate their concepts of an inventory and tabulate or categorize these concepts on the board.
2. Determine the common line of thought throughout the various interpretations.
3. Establish a concensus (definition).
4. Ask the question: "What purpose do inventories serve?" or "In what areas would an inventory be needed?"
5. It might be suggested, after areas have been identified, that one such area serve as a trial inventory which would involve all students at the onset of this experience. (Example: The classroom)
6. Determine all of the items found in the classroom (all items that are an integral part of the room.)
7. Ask the question "Is it enough to list these items?" "Are there other factors necessary to give them meaning?" (size, shape, number, quality, etc.)
8. A discussion is necessary at this point to judge the value and significance of information tabulated. It may lead off with inquiry relative to the overall evaluation of the room and its contents. If other rooms were included in this experience, comparisons can be made (being careful to consider purpose for which each room is designed.)
9. Conclude this activity by asking the students to define the various stages in the process and to put them in a logical sequence. Have the students give reasons for their arrangement.
10. "To what other areas of concern can these stages or this process be applied?" The responses to this question should suggest the need for further activities (of which a few are presented here) and should lead to further application and development of the skills used in inventorying.

This unit is a compilation of suggested inventories. There are many other areas which could be inventoried, depending primarily on student and teacher interest and availability of resources.

Materials:
Chalk board
Chalk, pencils

ACTIVITY B: USING RESOURCES

Teacher's Note:

In many inventory processes, it will be necessary to make use of resource persons, publications, and the like. It will be necessary for students to judge the need for, use of and reliability of a resource.

1. Define the inventory to be made. If possible, state the inventory objective in terms of a question.
2. Determine the need for resources in order to answer the question or solve the problem.
3. List where these resources can be located. (person, literary material, films, etc.)
4. Prepare preliminary questions to be answered by the resource. These questions exist where no immediate answer is available without the use of the resource. All should be as concise as possible.
5. If necessary. notes should be extracted from the use of the resource and implemented in the setting-up of the investigation.
6. Careful documentation on the resource and its application to the process should be retained.
7. At the conclusion of each activity in which a resource played a part (major or minor), evaluation of that resource is necessary for future use.

Materials:
(All are not needed. It depends upon the specific resource.)
Film, filmstrip catalogs
Telephone directories, telephone
Stamps, stationery, pens
Transportation

ACTIVITY C: STUDENT COMMUNITY INVENTORY

Teacher's Note:

This activity is an extension and exercise of student skills.

1. Have students list all of the general areas within their communities which might be inventoried.

2. An attempt should be made to categorize all the possible inventory areas under general headings.
3. Invite a member of the planning commission to discuss these categories, and make suggestions to include or delete as the situation dictates.
4. The class must decide what information must be gathered about each inventory area. These categories should be listed on a fact worksheet and duplicated so that each student has a copy. The student will then gather and record all the information pertaining to his pre-determined personal area of the school district. (This will also prevent overlapping of information, except for those students who live on the same street or in the same designated area.)
5. Compilation is necessary. Use the chalk board or paper placed on the wall for this. Information should include — among other things — physical structures (homes, businesses, streets, cars, etc.) and quality (condition of physical structures), etc.
6. Comparisons can be made and relationships can be drawn, so that students can perceive what new knowledge they have acquired from using the inventory process. It might be helpful to start a class list of findings about the community. Additions could then be made as small groups and individuals pursue their own inventories. When the unit is completed, this information could be organized and bound and presented to the school library as a local resource. (Make the connection about using others as resources and the student acting as a resource for others.)

ACTIVITY D: POLLUTION INVENTORY

Teacher's Note:
This activity may be used by the entire class as practice in inventorying or by small groups. It may be more feasible to use photographs and pictures if leaving the school building is not possible.

1. Identify or isolate a topic of interest concerning the effect of pollution on the city, on the countryside, etc.
2. List the differences and likenesses that were observed.
3. Look for signs of dirt and soot on houses, plants, windows, other buildings, etc. Find and list sources and location of dirt and soot.
4. List where dirt and soot were observed; where they came from; where there were clean areas; why? Could the dirt and soot be stopped? Why? How?
5. a. Decide whether the source of pollution is an important (essential) part of the community and how there can be a solution:

   Example:
   The expressway is a source of pollution in our city. Must we stop using it? Why? Why not? Can we do anything about it? What? How can we do it? Whom do we contact?

   b. Debate the pros and cons:

   Invite a knowledgeable member of the community to speak and answer questions on the topic. Write to your congressman. Prepare a display; have an ad campaign in support of your viewpoint.

Materials:
Two pictures: one a quiet country scene, one an industrial site.

ACTIVITY E: SOUND INVENTORY

1. Prior to class, make a tape of environmental sounds; have student(s) help. Include a factory whistle, train, boat, cough, traffic, voices, etc.
2. Play the tape as the class enters the classroom or soon after. Check the comments, keep in mind those sounds identified first. (You may have to jot the comments down.)
3. Decide if the sounds are "noise." Why? Why not? What do the sounds mean? Is there anything else associated with them? (Dirt, odor, health, fuel, energy, etc.)
4. Stand on a busy street corner. Take a poll of vehicles, sounds, numbers of people in each vehicle and other activities. Poll sheet should relate to specific topics arrived at during discussion in 3.

   Notice buildings, glass, plants, water puddles along the edge of the curb where you are standing. Notice the floors at the entrances of the buildings, the odor of exhaust, the haze from exhaust, the sky, people's faces, animal life, etc.
5. Discuss information gathered: buildings, floors windows, plants, sky, etc. Were the lists that you made before the trip outside realistic? Could you develop a better list now? Why?
6. The teacher may choose to have the various groups compose inventory sheets that are more effective. Then allow the students to retake the trip outside.
7. Decide if the vehicles were used efficiently. Why? Why not? Did you see happy faces? Why? Was one side of the street different from the other as far as dirt and haze were concerned? Why? (Wind pattern and traffic flow may make a difference.)

In comparing all the lists, do you see new questions?

ACTIVITY F: EFFECTS OF POLLUTANTS ON PLANTS

Teacher's Note:
Teacher or students may choose to do a particular experiment or all of them, as individuals or in small groups. Class should decide on intervals of observation and length of experience.

1. Show a picture of a tree at the side of a road, that appears to be dying from vehicular exhaust or salt, or bring a plant from the edge of a street or parking lot that is covered with tar, oil, dust or generally unhealthy.
2. Compare unhealthy plants to healthy ones in the classroom.
   a. List differences.
   b. List possible causes for the dying tree in the picture and the unhealthy appearance of the

plant from the parking lot. (Exhaust, salt, oil, car wash detergent, etc.)

c. Simulate some of these conditions in the class room by lightly covering the top-side of one of the healthy classroom plant leaves with Vaseline.

Cover the underside of a different leaf with a thin layer of Vaseline. Record what happens.

d. Send a dependable student into the school yard to get several small plants — any kind — and some soil; replant in small milk cartons or aluminum dishes.

(1) Sprinkle salt on the soil of one of the replanted plants and water regularly with tap water.

(2) Mix 4-5 drops of light-weight 3 in 1 oil in the soil of another replanted plant. Water regularly, with a drop of oil in the water each time.

(3) Mix 4-5 drops of detergent in the soil of another replanted plant. Water regularly with a drop of detergent in the water each time.

(4) Keep one plant as a control, do not contaminate the soil. Water regularly with tap water.

(5) Record observations regularly; include information on conditions — watering time, sunlight, etc.

Make a chart of the observations, or draw or photograph changes. Mark observations carefully.

3. Take a poll of the street as you walk home from school. Just look.
   a. Which side has the healthier plants? Why?
   b. Which side has cleaner buildings?
   c. Compare sides of houses or apartment buildings; are there differences? Why?
   d. Are there sources of pollution nearby? List.
   e. Are plants taller/healthier near or away from the street?
   f. Check plants near driveways. Are they healthy?
   g. Is there residue on the leaves?
   h. Is there residue on the soil around them? Why? List.
   i. Check puddles. Is there residue?
4. Discuss which side of the street or highway has healthier plants? Of the driveway? Why? Refer to list above.
   a. What was the residue on the plants? Why?
   b. How do you think the plants would be affected in the winter? (Salt, etc.)
   c. What was the residue on the puddles? Why? etc.
5. Display charts, plants, any drawings made or photographs taken to substantiate information collected and conclusions drawn.

Materials:
pictures of dying trees at a roadside
several plants
vaseline
salt
3-in-1 oil (household oil)
detergent

ACTIVITY G: EVALUATION OF INTRODUCTION TO THE INVENTORY PROCESS

Teacher's Note:
It will be well to determine the readiness of the students to pursue more specific inventories by considering their understanding of the basic structure of the process.

The following is an example of the questions that must be considered in a survey:

1. Goal or objective of the study:
   a. Is it clearly and concisely stated?
   b. Is it attainable?
   c. Is there sufficient time and equipment to complete the investigation?
2. Resources needed:
   a. What background material and information is needed before the study starts?
   b. What resource people are available to assist in the investigation?
   c. What supplies and equipment are needed?
   d. Do I have the qualifications necessary to operate the equipment?
3. Procedure and schedule:
   a. What is the order of events in the investigation?
   b. Is the order logical?
   c. Must one phase be complete before another begins?
   d. What are alternative methods in the event a problem is encountered?
   e. Do all members of the investigation know their duties?
   f. Are all members prepared to do their part?
4. Methods of data collection:
   a. What means will be used to collect the data?
   b. How much and what type of data is necessary?
   c. What supplies, such as work sheets, are needed in data collection?
5. Methods of data analysis and interpretation:
   a. How will the data be analyzed and interpreted?
   b. How much time will be necessary to do this work?
   c. Who will be assigned the responsibility?
6. Report:
   a. Does the report include all essential components of the inventory?
   b. Is it a clear and concise discussion of the investigation?
   c. Are the conclusions substantiated?

EXPERIENCE #2:
INVENTORY OF PLANTS AND ANIMALS

OBJECTIVE:

Students will be able to conduct an inventory by various methods to determine the kinds and quantities of plants and animals within their communities.

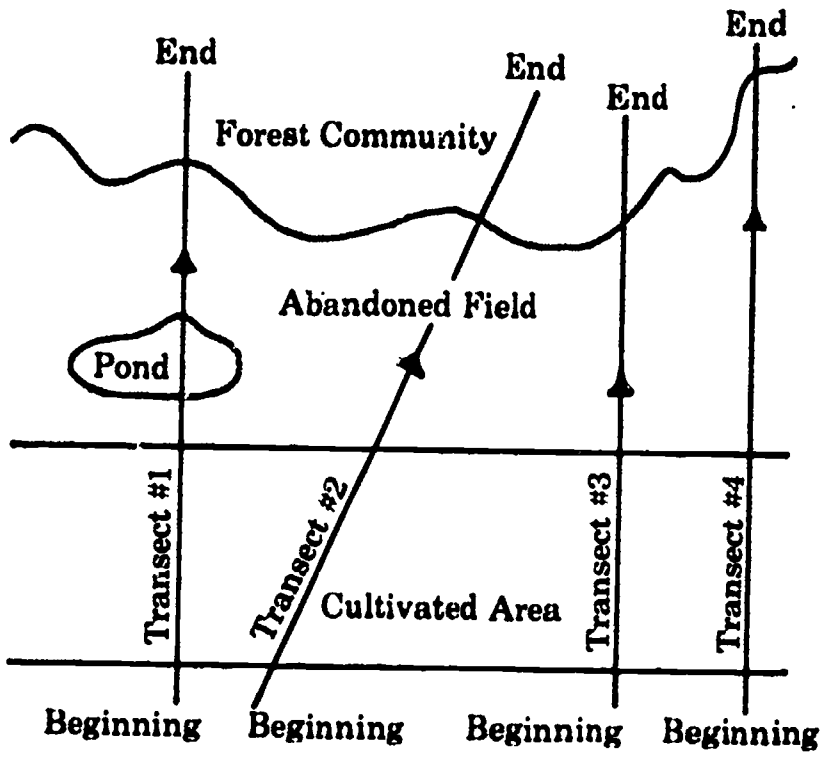
Teacher's Note:
Determining the number of animals in an area is a difficult task. Unlike plants, animals are secretive and they move; they do not conveniently stay in one place as do plants. In addition, most mammals are nocturnal. Their habits and behavior are different from those of man.

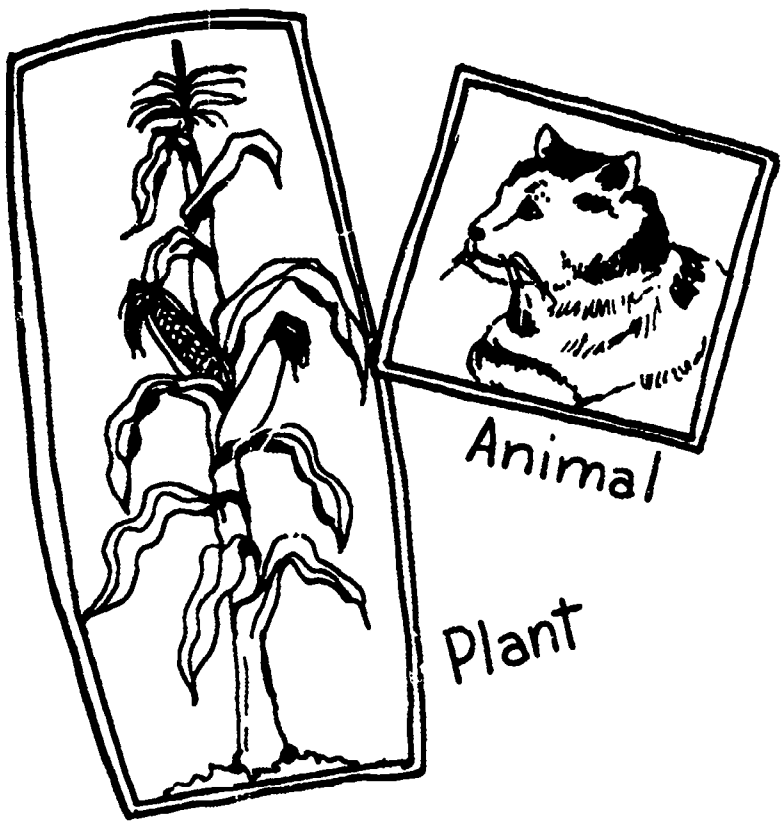
Because of the great emphasis on the management of wild animals, considerable work has gone into the development of techniques and methods of collection and analysis of data.

Several types of methods are provided below. As with the plant community inventory, some methods are more appropriate for particular species or localities than others. Be sure to select those suitable to the requirements of the inventory. The methods are more suitable for a survey of game species than of non-game species.

ACTIVITY A:
THE LINE-INTERCEPT METHOD

Teacher's Note:
This method is particularly valuable when the area to be inventoried passes through several types of communities. It is useful in determining the changes of an area, especially as related to the movement of the edges of communities. It is rapid, objective, and relatively accurate. The area may be determined directly from recorded observations. The lines can be randomly placed and replicated to obtain the desired precision. The method is well adapted for measuring changes in vegetation if the ends of the lines are well marked. Generally, it is more accurate in mixed plant communities than quadrat sampling and is especially well suited for measuring low vegetation. However, this method is not well adapted for estimating frequency or abundance, since the probability of an individual being sampled is proportional to its size. Nor is it suited where vegetation types are intermingled and the boundaries indistinct.





1. Identify the area to be surveyed, measured in square meters.
2. Determine the number of line-transects needed to represent the area.
3. Layout a string or steel tape the total length of the transect.
4. Identify and count each plant or community type that touches the string.
5. Record on the data form the type of plant or community and its distance from the beginning point.
6. The data can be summarized in a variety of ways:
   a. The number of times each individual species appears along the line.
   b. The percentage of occurrence for each species in relation to the total.
   c. Total linear distance in centimeters of each species along the belt.
   d. The total distance of intercept by all species.

A map showing the transect lines and community types of plant species is very helpful in visualizing the area.

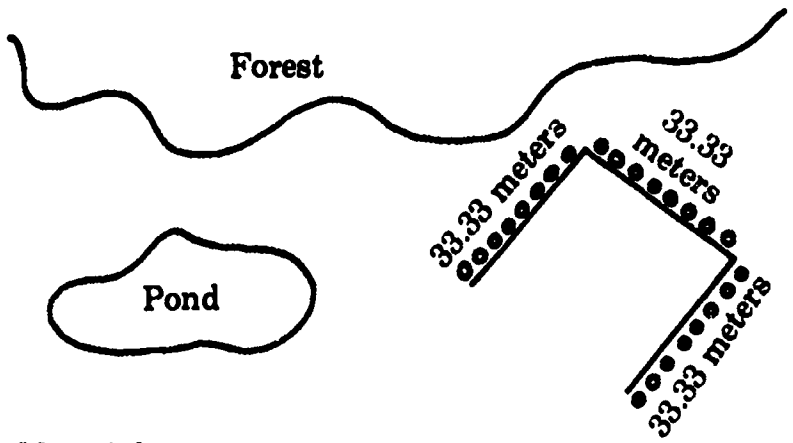
Materials:
String or rope many meters long (100 m.)
Wooden stakes or lead pipes (10-20)
Data sheets
Measuring sticks

Botanical field guide(s)
Pencils
Dress according to weather.

ACTIVITY B: THE LOOP METHOD

Teacher's Note:
This method, as the name implies, relies on using a loop to sample the community. It is simple, accurate, and provides concrete measurements of community composition, and over a period of time trends and changes in the community. Its use is limited to communities comprised of grasses and low-growing vegetation.

1. Construct a wire hoop 2 cm. in diameter.
2. Locate a random point in the community and stretch a tape.
3. At each observation point, place the loop to the right of the tape and record the identity and number of species in the hoop.
4. When the 33.33 meter point is reached, another line is run, and the procedure is repeated. This is done a third time, thus bringing the length of the transect line to 100 meters.
5. The data is reported in percentage of occurrence.



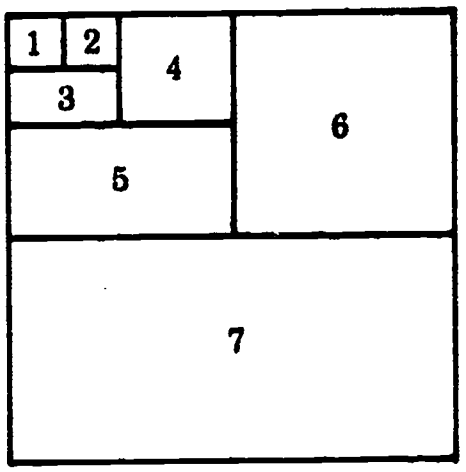
Materials:
Wire
Tape line
Data sheets
Field manuals
Pencils

ACTIVITY C: BELT TRANSECT

Teacher's Note:
A variation of the segmented-belt transect consists of taking observations only on alternative segments. Using this variation, precision seems to be affected very little (Oosting, 1956). For example, 10 quadrats alternately spaced on a 20-foot belt are nearly twice as efficient statistically as 10 quadrats on a 10-foot belt.

The belt transect can be set up as follows:

1. a. Determine the total area of the site to be sampled, then divide by 5 or 10 to obtain the total number of sample sites.
   b. Lay out a series of belt transects of a predetermined width and length sufficient to embrace the area to be sampled. Then divide the belts into equalized segments. These are sometimes



An example of nested quadrants

called quadrats or plots, but they differ from true quadrats in that each represents an observational unit rather than a sampling unit.

   c. The vegetation in each unit is measured for some attribute, depending upon the problem at hand: abundance, sociability, frequency, stem counts, etc.

2. The line-intercept method (an alternative):
   The line transect is one-dimensional. It consists of taking observations on a line or lines laid out randomly or systematically over the study area.
   a. Stretch a metric steel tape or steel chain between two stakes 33.5 meters, or one chain, apart.
   b. Consider the line to be a belt one cm. wide extending along one side of the tape.
   c. Move along the line and record each plant species found along its transect.
      (1) For grasses and dicot herbs, measure the distance along the line at ground level.
      (2) For shrubs and tall dicot herbs, measure the "shadow", or distance covered by a downward projection of the foliage above.
   d. Determine:
      (1) The number of times each individual species appears along the line.
      (2) The percentage of occurrence for each species in relation to the total.
      (3) Total linear distance in centimeters of each species along the belt.
      (4) The total distance of intercept by all species per 30-meter line.

ACTIVITY D: STRIP CENSUS

Teacher's Note:
The strip census, or king method, is widely used to estimate the populations of various species of animals, particularly ruffed grouse and snowshoe hare. The procedure includes walking on a line through the area and counting the number of individuals that are flushed.

1. First the area must be marked out in a grid, the distances between the lines being one-quarter mile.

2. The observer (or preferably observers, one for each line) walks the grid line, counts the animals observed, and records the distance at which they are flushed from the line.
3. The average flushing distance is determined by adding up all the flushing distances and dividing this by the number of flushes made. This figure is then used to calculate the effective width of the strip censused, obtained by multiplying the total length of the line walked by the average flushing distance.
4. The population for the entire area is the number of animals flushed, divided by the area of the strip and multiplied by the total area:

$$P = \frac{F}{2yx}\ (A),$$

where
F = number of flushes
A = area of study
y = average flushing distance
x = length of time

5. The flushing distance, y, is multiplied by 2, since the distance is applicable to both sides of the line walked.

ACTIVITY E: ROADSIDE COUNTS

Teacher's Note:
Roadside counts are used chiefly to obtain an approximation of the population of certain animals. The number and kinds of animals observed along a particular roadside is recorded and the results divided by the number of miles involved in the study.
This study might also include counts of plant life.

1. Determine several routes to be taken in this study and determine the different times each site will be inventoried.
2. The distance to be covered should be not longer than it would take one hour to cover.
3. Transportation may be done by vehicle.

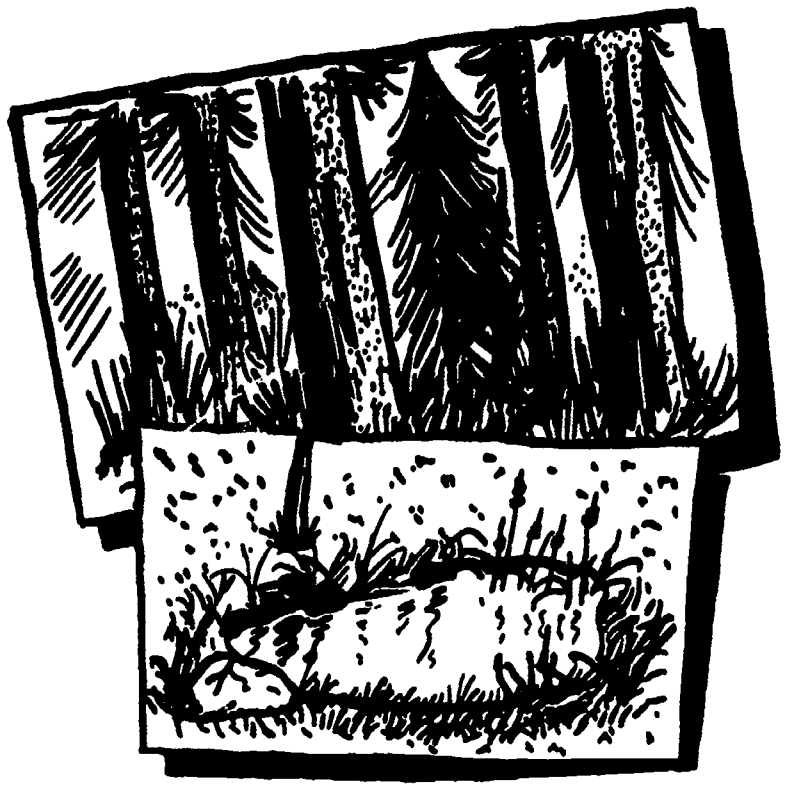
Materials:
Data sheet
Car
Watch
Pencils

EXPERIENCE #3: INVENTORY OF HABITATS AND ECOSYSTEMS

OBJECTIVE:

The students will complete an inventory of a habitat and ecosystem within his community.

Teacher's Note:
This experience will direct the student towards an inventory on which he works either individually or in small groups. The inventory should be confined to an area of interest to the students. It will be necessary to place some limitations on the projects, as determined by the time, equipment, and policies of your school.



The teacher's role here is as a resource of information. If the student needs a specific item, literary or material, the teacher should discuss with the student the ways and means of getting it. The key is that the student must ask the question. At times it will be necessary to pull the question out of a group when it is confronted by a limitation that seems impossible to get around. The teacher should also make progress checks to see how the groups are doing during their inquiry.

Research will begin with each independent team researching a process in order to reach a level of understanding that they have specified in their problems. Primary investigations in the community could take place during class time, study halls, or after school, whenever time and transportation can be worked out to meet the student's needs. Class time should be centered around discussion of problems, literature research and analyzing data. They will make many mistakes but profit from all of them. They will develop their process as a team and become a vehicle in learning to reach an accurate estimation of a wildlife population.

ACTIVITY A: PRELIMINARIES OF A HABITAT INVENTORY

Begin by narrowing the intent of the inventory. Some initial questions are these:

1. How can the inventory be conducted best? What will be the area of the inventory? How will the students show that their survey is accurate?
2. It will be useful to determine where everyone lives. Plot the students' homes on either a large scale map or a transparency. Some students may live in an area surrounded by extensive open lands which might be suited for the inventory. If the land is privately owned, be sure to obtain permission before the inventory is started. If little land exists, perhaps an alternative can be a city or metropolitan park, a cemetery, or a vacant lot.

Have the students consider how large an area would be necessary to conduct the study and still be feasible, based upon the limitations previously mentioned.

3. Discuss the various methods and techniques, and decide which ones would be most suitable for the study.
4. Be sure to consider the resources in your community that would be of benefit in the inventory.

ACTIVITY B: MAPPING A HABITAT

1. Take a blank sheet with your grid lines drawn on it and pace out the exact location of streams, stone walls, edges of cover tapes, large trees, etc. It helps to make a pacing scale on a piece of cardboard. For example, mark off intervals that, on the map, are equal to 10, 20, and 40 of your paces on the ground.
2. One inch to 104' 4½" is a good scale for your map. This means that each acre is 4 square inches in area. Where plants and animals are abundant, you will find that you need this much space in making your field notes. A block of 20 such units fits nicely on an 8½ x 11 sheet of note paper, depending on the size and shape of your area.
3. You may want a separate map for each species inventoried. If so, prepare additional worksheets before you start the census. Sheets 8½ x 11 ruled off into 20 squares with ink, or printed on a duplicator, are practical. Place an index tab on the bottom of each to aid in turning quickly to the sheet for a given species.
4. Important landmarks can also be recorded, or if you prefer to keep your worksheets uncluttered, fasten a more detailed map of the area, showing the relation of various landmarks to the grid inside the cover of your notebook.

Materials:
Paper (8½ x 11)
Measuring device
Notebook

ACTIVITY C: DISCUSSION OF AN ECOSYSTEM

1. Guidelines for student discovery
   a. How are you affected by the sun?
   b. How are the green plants affected by the sun?
   c. What other factors affect the growth of plants?
   d. How is the sun related to a deer?
   e. How are the sun and green plants related to a deer?
   f. How are the sun and green plants and deer related to a mountain lion?
   g. Other than the sun, green plants, and deer, what factors would affect the population of mountain lions?
   h. What non-living factors affect mountain lions?
   i. All relationships between the physical environment and the living environment experienced by the mountain lion are the ecosystem of the mountain lion.
   j. What plants and animals make up the ecosystem near your house?
   k. How are they related to each other? Draw a picture of all living and non-living factors and connect their relationships to one another by lines. Be able to state the reason that you have for connecting factors with lines!.
   l. Make a closed ecosystem in your classroom. You will need a gallon jar with a wide mouth, 1 or 2 small fish (guppies or goldfish), sand, soil, aquatic plants, water, and a cap.
2. Development
   a. What natural wildlife forms are found on your plot? (populations)
   b. Are any of them found in a particular area of the plot? (habitat)
   c. Are there any reasons you could cite to explain why an animal would live in a certain area? (limiting factors)
   d. What relationships can you cite between wildlife and other wildlife, and between wildlife and non-living things? (ecosystem-interacting unit of wildlife)
   e. Cite all wildlife communities in your area.

ACTIVITY D: HOW TO MAKE A TERRARIUM

Teacher's Note:
This activity will serve as an initial step toward introducing the concept of habitats and ecosystems.

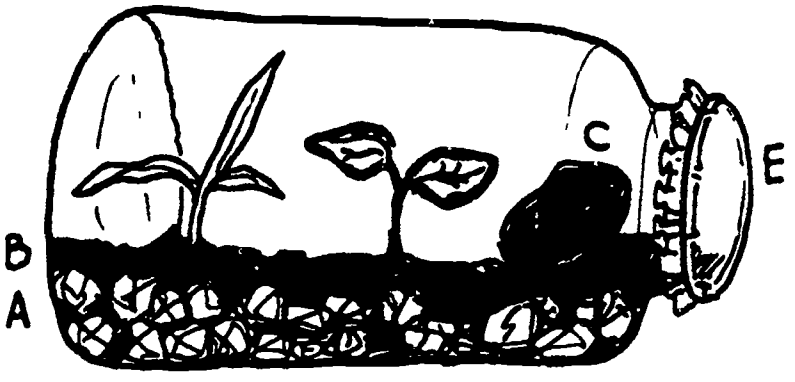
1. Have students bring soil, rocks, plastic wrap, and small plants of any kind.
   a. Clean gravel in hot water (free it from oil, salt, and detergent).
   b. Dry gravel by evaporation or sunlight.
   c. Place gravel in bottom of large jar.
   d. Place soil on the top of the gravel.
   e. Place plants. Be sure roots are covered. (Include some bark with licen or moss. It grows anywhere there is shade: in cracks in sidewalks, near old foundations, between bricks on shady side of buildings, etc.)
   f. After planting, place charcoal near the side of jar.
   g. Drop about 2 teaspoons of tap water over plants and on soil; seal using plastic wrap and rubber band. (If there is concern about someone poking a hole in the seal, this will emphasize man's part in disrupting an ecosystem!)
   h. Place terrarium on a windowsill that gets some light.
2. Go outside into playground and locate an ecosystem. (Define what one is.)
   a. An area about one-foot square will work. Do not mark it in an obvious way, use string or plastic spoons sunk into the ground.
   b. List the kinds of plants and animals and the general condition: soil-soft, hard, wet, dry, etc.
   c. Check spot daily; take inventory of what is there, what has changed. Drop some crumbs. What happened?

d. Decide on length of time to watch terrarium and outdoor spot. Record growth of plants. Plot on charts.
e. Show drawings or photographs of the outside spot and its changes by students.

3. Discuss
   a. Compare inside ecosystem and outside one: growth, color, etc.
   b. What was noticeable in the inside one? (Condensation, transpiration, growth of small organisms.)
   c. What was noticeable in the outside one? Effects of the natural elements, soil changes, possible erosion, effects of the human element (trainpling, pulling out), animal life.
   d. If someone poked a hole in the plastic seal, tape the hole or put new plastic over old and use another rubber band. Discuss why a hole could be poked in the seal. (Teacher could contrive this situation.)
   e. Check to see if cycle continues after seal is replaced. Why? Why not?
4. Determine why we washed the gravel before we put it into the terrarium.
   a. Why would someone want to poke a hole in the seal?
   b. Why was the spot outside different?
   c. What does the inside spot share with the outside one? What don't they share?
   d. The two communities that were watched are ecosystems. Why? Define.

Materials:
potting soil
gravel
charcoal
plastic wrap
plants
rubber bands
large jar
hot water

TERRARIUM



JAR

PLANTS	WATER
A. Gravel	C. Charcoal
B. Soil	D. Plastic Wrap

ACTIVITY E: PLOT ALL ECOSYSTEMS ON YOUR MAP OF AREA

1. Discuss
   a. How will you depict these ecosystem areas? What colors will you use? What symbols?
   b. How will we plot them accurately to scale?
   c. What people in our community can help you?
   d. Geologic features could be plotted, but the difficulty will be greater.
2. How accurate is your map? How could you find out? Compare to a government topographical map of your area. Did you plot ecosystems accurately? Woodlots, fields, rivers, and streams?

ACTIVITY F: THE EFFECT OF SOIL QUALITY ON PLANT GROWTH

Teacher's Note:
Invite an agriculturalist to visit the class and relate certain aspects of planting and the environment.

1. Plant seeds in various containers.
   a. Plat several seeds in holes in a sponge. Place sponge in a container or in an extra milk carton.
   b. Plant 4-5 seeds in potting soil in a carton.
   c. Plant 4-5 seeds in soil from the edge of the parking lot.
   d. Plant 4-5 seeds in soil with ¼ teaspoon of salt mixed in it.
   e. Plant 4-5 seeds in soil with ½ teaspoon of motor oil in it.
   f. Plant 4-5 seeds in soil with detergent mixed in it.
   g. Label each container with details of planting. Label plant #b as a control. Water each regularly, including the sponge. Plant left-over seeds in separate milk cartons.
   h. Record growth and changes on a chart.
2. Find an ecosystem that is established near a highway or a waterway.
   a. List members in the system: plants, animals, etc.
   b. Observe general health of plants.
   c. Check erosion or run-off pattern (related to highway).
   d. Study wind direction in relation to nearest industry or city.
   e. List organisms that are dependent upon chosen ecosystem. Check soil, keep plant cycle in mind.
3. Discuss
   a. Discuss the inside plant life and growth pattern, considering the variations in the simulation.
   b. Discuss the outside ecosystem, the differences, the similarities.
   c. Which group is dependent? Why?
   d. Why was it necessary to plant seeds in a sponge for this project?

4. Decide why certain seeds grew to be more healthy than others.
   a. Could similar conditions exist for natural ecosystems? Why?
   b. Why would an ecosystem near water have different data than one near the highway?
   c. Could conditions arranged in the classroom represent *phytotoxic* examples?

Materials:
3 or more small milk containers
1 small sponge
potting soil
bean or corn seeds

EXPERIENCE #4: INVENTORY OF THE PHYSICAL ENVIRONMENT

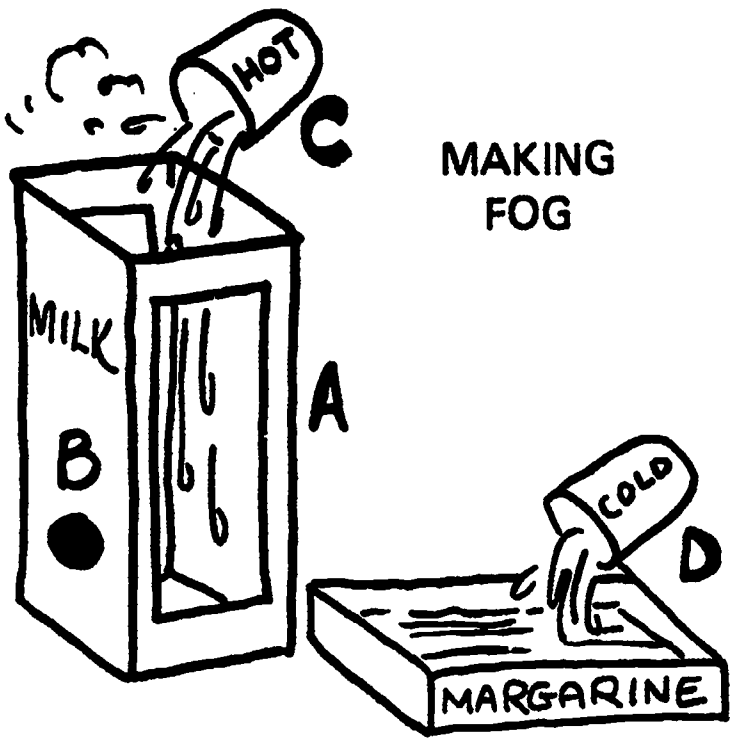
OBJECTIVE:

1. The student will understand the need for a cleaner environment.
2. The student will understand the relationship between radiant energy and living things.
3. The student will understand the effect of pollution on the health of man.

ACTIVITY A: MAKE A FOG AND SMOG CHAMBER

Teacher's Note:
The term "smog" began by combining the word smoke *and* fog. *Today it generally means a persistent condition of contaminates in the atmosphere: hydrocarbons, oxides of nitrogen and sulfur, dirt, smoke, dust, and carbon monoxide over a certain location. The pollutants cannot be dispersed because meteorological conditions exist that do not allow it. Smog is characteristic of large cities, small ones, and rural areas, too. Bodies of water absorb heat and contain much energy, which does not allow quick changes in temperature. This can effect fog and smog in particular areas. Topography can be discussed.*

1. **Making Fog**
   See diagram:
   a. Cut top off carton, cut windows in two opposite sides, cover windows with plastic wrap and tape it down. (A)
   b. Cut 1-inch hole about 1½ inches from bottom on one windowless side.
   c. Put about ¼ inch hot water in the bottom of the carton. (C)
   d. Put about ¼ inch cold water in the margarine tub. (Use ice cubes if they are handy.) (D)
   e. Put cold water on the open top. Allow the tub of cold water to remain until there is evidence of air currents. Observe speed of the air movement.
   f. Light a match, blow it out, drop it into the hole (B) and let it smoke.



MAKING FOG

2. **Making Smog**
   Empty the tub and the carton. Fill the tub ¾ full with hot water. Place tub on the top of the carton, as in the diagram. Do not use cold water this time. In the base of the carton, place a piece of lighted incense.

   Observation:
   With hot water on top, the air currents are sluggish, if noticeable at all.

   After carton is filled with smoke, take the incense out, add slowly an ice cube or very cold water. (A watering can or pitcher can be used.) More hot water may be needed.
3. Notice movement of air currents (cold air moves downward; warm, upward in a cycle). List what happens; draw a diagram.
4. Record temperature at regular intervals each day for a specific number of days decided by participants.
   a. Make a list of temperature and general weather conditions or specific concerns identified earlier.
   b. Check odor of air; fog; or smog; density; etc.
5. Discuss:
   a. Find reasons for differences in temperature A.M. and P.M.
   b. How does fog or smog relate to temperature?
   c. Why would fog form near a river at night?
   d. How does the information gathered relate to fog and smog experiments?
6. Decide:
   a. Is fog or smog a problem in local community? Why, why not?
   b. Why might fog be denser near cities?
   c. How does fog or smog relate to local community's location?
   d. Display projects and materials collected so that comments and evaluations can be made.

Materials:
Two ½ gallon milk cartons
plastic wrap
rubber bands
aluminum dish or margarine tub
hot water
ice cubes
matches
incense
scissors
cellophane tape

ACTIVITY B:
CLOUD BEHAVIOR

Teacher's Note:
This activity should promote enthusiasm about weather changes and causes for cloud patterns. Many students have the causes and patterns in their past experience; this exercise will allow them to relate past knowledge to local conditions. For those who do not have this past experience, the activity could be used as a motivator for a weather unit.

Weather predicting interest may evolve. Refer to a general science text, aneroid and mercury barometers, and daily weather maps for information.

1. Look at the sky. Open window momentarily.
2. Notice clouds, their color, their movements.
   a. List what can be seen of the sky.
   b. Check sky at regular intervals. Class decides the intervals.
   c. List changes, causes for change.
3. Explore areas in community where combustion, incineration, attrition take place. List them.
   a. Relate location of community to these places.
   b. Locate nearby bodies of water and state direction in relation to school window. Locate nearby city in relation to school window.
4. Discuss the differences of clouds at different times and the location of school window relative to possible polluters, and relate location of window to body of water. Discuss the effects. Can cloud pattern and wind pattern be predicted?
5. Decide why clouds move in a certain direction and why they are different colors, etc.
6. Post collected data so that deductions can be made from the material.
   a. Is the neighborhood where students live "down" wind from the source of pollution? How does that affect the neighborhood? Does a lake or river have an effect? How?
   b. How would neighborhoods in the opposite direction from the source of pollution be affected? Why?
   c. What could be done in planning neighborhoods to change some of the conditions?

ACTIVITY C:
ABSORPTION OF HEAT

1. Absorbing Reflecting Demonstration (see diagram).
   a. Cut out pieces of black construction paper to cover one side of each of two of the milk containers. Glue the paper to the cartons.
   b. Make small holes in the sides adjacent to the covered sides. The hole should be in approximately the same place on all three of the cartons.
   c. Insert a laboratory thermometer* in the holes in each of the containers. Be sure that the thermometers do not touch the sides of the cartons. Anchor them in the holes with rubber bands if the thermometers do not stay in place. (Wind a rubber band around the thermometer several times at the place where it should be placed in the carton. The extra thickness of the thermometer will hold it in place.)
   d. Label one carton A and describe it. Example: black paper container standing straight. Label a carton B and describe it: black paper container slanted against a brick or book. Label the last carton C and describe it as uncovered and standing straight.
   e. Testing time: Let stand for 10 minutes, then record temperatures. Repeat at intervals. Be sure that the covered sides of the cartons are facing the sunlight.

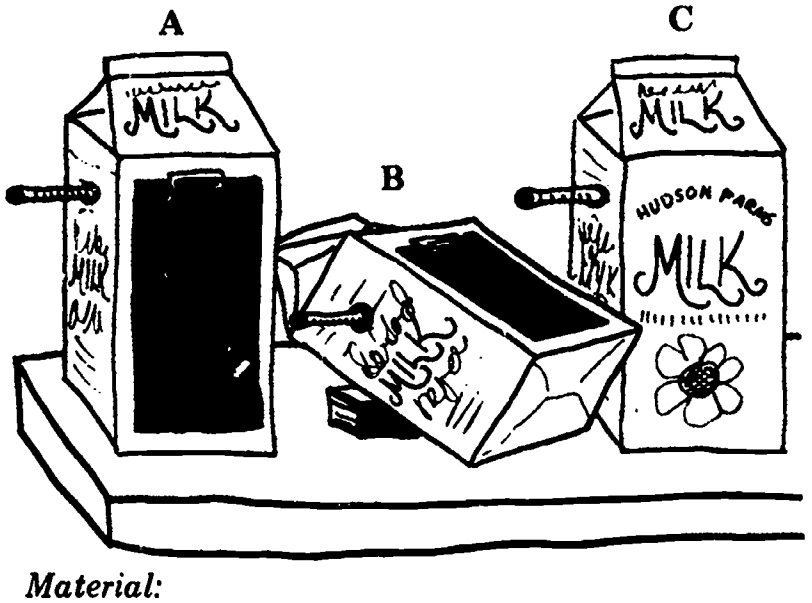
*May use Fahrenheit and/or Centigrade thermometers.

2. Place the one container without black paper on it and with the thermometer inside, not touching sides, on a sunny window sill.*
   a. Place a black-covered container with thermometer inside on the same window sill, standing straight.
   b. Place the other black covered container on the window sill in a slanted position.
   c. Take readings at regular intervals; list differences in temperature between containers.
   d. Continue readings for length of time determined by class.

*Each student could make a set, if time and space permits.

3. Visit playground and parking lot.
   a. Measure the temperature of the cement. Hold thermometer 1 inch from the surface.
   b. Take the temperature of the black-top. Hold thermometer in the same way.
   c. Holding the thermometer the same way, measure the temperature of a chrome auto bumper.
   d. Measure the temperature of a level grassy area in the same way.
   e. Measure the temperature of a grassy area on a slope, holding the thermometer the same way.
   f. Measure the temperature beneath a tree or bush.
   g. Take the temperature of any available puddle of water that is standing in the same general area in the same way; do not dip the thermometer in the water.
   h. Record the temperatures. Do this on several different occasions.
4. Discuss the difference in temperature. Relate these to past experiences.
   a. Why take temperature of a flat grass area and one on a slope?
   b. Compare outside patterns to inside boxes on sill.
5. Decide
   a. the reasons for temperature differences in dull black vs. shiny white surfaces, etc.
   b. the reasons for temperature differences between slanted and flat or straight surfaces.
   c. whether it is easy to work with thermometers.
   d. why the slanted container had a higher temperature. (This relates to the slant of the earth and its axis. It could give an additional opportunity to do research.)

ABSORBING REFLECTING DEMONSTRATION



Material:
3 - ½ gal. milk cartons
black paper
glue
5 thermometers
scissors
sunny window sill

ACTIVITY D: POLLUTION AND RESPIRATORY ILLNESS

Teacher's Note:
This exercise may develop into a very sensitive subject. Be prepared to guide students through rough spots when their objectivity gets clouded by emotion. Student consideration for the individual is an important part of this exercise.

1. Use news articles about illnesses to draw comments.
   a. Set up books from library (if available).
   b. Find out if anyone knows anyone with an illness mentioned in any of the clippings.
2. Collect articles from local paper about respiratory illness.
   a. Check periodical guide for current articles.
   b. Report on various forms of respiratory illness. Collect and report on radiation exposure.
3. Visit the local chapter of the National Tuberculosis and Respiratory Disease Association.
   a. Gather information concerning the local community; relate it to national percentages. Interview a member of the staff.
   b. Visit a local clinic and find out percentages of respiratory patients admitted.
   c. Is there a particular season of the year when the percentage is higher? Lower?
   d. Interview someone on the rescue squad or fire department. Ask whether they have contact with people with respiratory illness in their emergency runs, etc.
   e. Who is affected? Get the percentages of different types: age, sex, etc.
4. Discuss these questions.
   a. Decide whether deaths due to respiratory disease are more common to certain areas, more common to men or women.
   b. Can illnesses be related to ways of life? Occupations? Associates?
   c. In discussing personal examples, are there certain patterns?
   d. Invite a professional, involved in the medical field, to come to speak about respiratory illnesses. Is it only air pollution that causes them?
   e. Display all of the charts, reports, interviews.

Materials:
Books from school or public library about respiratory ailments, eye and skin disorders, health problems in general.

Clippings from the newspaper about lung, throat, cancer, heart problems, colds, coughs.

ACTIVITY E: POLLUTION AND ACCIDENTS

1. Collect articles about accidents caused by fog, smog, haze, or carbon monoxide poisoning.

2. Check the local community to see if there is a haze pattern.
   a. Record time of day and conditions.
   b. Check wind direction, if any. Record.
   c. Check temperature, other conditions. Record.
   d. Relate air pattern and industry that is closest. Describe.
   e. Relate air pattern and river, lake, etc., nearby or freeway nearby. Describe.
   f. Plot all the relationships, d and e, on a large sheet of paper.
   g. Check to see if there have been recent deaths due to carbon monoxide poisoning of children (or adults) sleeping in the back seat, etc., of cars while travelling, or attacks or seizures of those with respiratory illnesses in heavy traffic or traffic jams.
3. Discuss all of the information gathered. Do any of the clippings pertain to the local community?
4. Consider these questions:
   a. Is there a chance that the local community might have conditions that could cause auto or air crashes?
   b. Are there alternatives? Discuss, using the material gathered.
   c. Display the large sheet with the local landmarks that may contribute to crash conditions.
   d. Consider topography and areas where haze, fog or smog settle. See Experience #2.

Materials:
Picture or article from paper concerning accident or crash caused by fog or smoke (smog).

ACTIVITY F: USE OF ELECTRICITY

1. Have lights turned off when class enters the room.
2. Electricity is used in many ways for many things.
   a. List uses — home, school, community.
   b. Take a poll from the classroom window. List ways it is being used.

3. Take a poll in school, at home, in neighborhood, etc. See examples of inventory sheets in the Appendix.
4. Compare lists. How many have the same examples listed? Why?
   a. How many examples insure human safety?
   b. How many examples add to human comfort?
   c. Place examples in the categories: personal, community.
   d. How many examples help plants, animals?
5. Decide:
   a. How many uses are absolutely necessary?
   b. How many uses are not necessary?
   c. Why are humans helped more than plants or animals?

ACTIVITY G: THE SOURCES OF POWER

1. Have lights turned off when class enters the room.
2. Find where the electrical current comes from by making a long flow chart on shelf paper.
   a. Start at the switch.
   b. Plot series of connections, the longer the better to get the idea of lots of conductors, poles, etc.
3. List all the different equipment needed to get electricity from the power plant to the school room.
   a. Of what are the pieces of equipment made?
   b. Where do they come from?

   Groups may be assigned specific types of equipment to research.
4. Study the power plant. What is its source of energy? Fossil fuel, nuclear, water (hydroelectric)?
5. Discuss all the information collected.
   a. Why did everyone notice when the lights were off the first day of this project?
   b. Is electricity important to humans? Other living things?
6. Relate how human use of electrical energy changes the community.
   a. Discuss what it provides.
   b. Decide how the power plant changes the area around it. Good, bad?
   c. Are all of the demands necessary? Why should we be concerned?

Materials:
Several feet of shelf paper
marking pens

EXPERIENCE #5:
CULMINATING ACTIVITIES

OBJECTIVE:

1. The student will conduct an inventory by himself or in a small group.

Teacher's Note:
The following are several inventories involving group or individual action in making inventories of the classroom, school, neighborhood, village, city.

The experience gained in the preceding sections can be applied in process approaches utilizing the total system — social, economic, and technical — to form judgments about demands of the local community.

The topics are suggestions only. The students should be able to arrive at attaining acceptable goals in responsible ways, thus allowing the teacher to take a subordinate position.

Promote the idea that what man has created, he can utilize and control through technology. If he doesn't know a solution, he has the ability to find one.

ACTIVITY A:
LAND DEVELOPMENT VS. SOLID WASTE

1. Where does the solid waste go in your community after trash pick-up?
2. Find out future plans for solid waste dumping area.
   a. Playground, housing development, etc.
   b. Check number of vehicles needed to keep the operation going. Check amount of fuel used (approximate).
   c. Check number of employees.
   d. What kinds of life exist in the area? List.
3. What do you think would be a good future for your community dump? Why?
   a. List suggestions and reasons.
   b. Isolate the most realistic ones and re-investigate possibilities.
4. Talk to or ask a knowledgeable person from the community, who is informed or aware of solid waste projects to visit your classroom.
   a. Find out how students can provide support on issues concerning solid waste.
   b. Find out about supporting health issues such as fly control, rat control, etc.
5. See article: "The Trade-Off For A Better Environment," *Business Week*, April 11, 1970.

ACTIVITY B:
RECYCLING

1. Find out if there is a recycling center in your community. What does it recycle?
2. How is the recycling operation performed?
   a. Collection: How? Where?
   b. Transfer of material: How? Where?
   c. Processing of material: How? Use of recycled substance? Waste products? How disposed?
   d. Demand for recycled substance?
   e. Workers employed: How many? Skilled - unskilled?
3. Discuss:
   a. Is the demand (for recycled substance) great enough to be realistic?
   b. Could you suggest a more effective way?
      (1) returnables
      (2) bottles instead of metal containers
      (3) less paper products, especially printed material.
4. After the various aspects of recycling are considered, what in your opinion is its chance for success? Why?
   a. What can you do to make it a success?
   b. What can you do to keep it successful?
5. See article: "The Trade-Off For A Better Environment," *Business Week*, April 11, 1970, page 63.

ACTIVITY C: EFFICIENCY

1. Is efficiency in using fuels a realistic way to approach an energy crisis? Has your community taken any action toward mass transportation, electricity controls, air pollution controls?
2. Find out if your community has taken any action on any (or all) of the above topics. Why? Why not?
   a. Approximately how many commuters use the streets in your community daily?
   b. Who uses your community shopping areas? Do they drive or walk?
   c. Are there restrictions on electrical advertising? How do the advertisers feel about the restrictions?
   d. Are filters used on stacks for air pollution? Why? Why Not?
   e. What does it cost to use control devices?

   An inventory of these topics can be taken by individuals or small groups, keeping in mind efficiency vs mandatory controls.
   a. Efficiency has an economic advantage.
   b. Mandatory controls involve costs.
3. Are the various types of fuel being used efficiently? Why? Why not? Use information from your inventory for discussion.

   Do you have enough information? If not, make up an inventory sheet and then gather more information.

   Apply new information to past and see if deductions about efficiency can be made.
4. Are costs related to avoiding controls?
   a. Could technology change this? How?
   b. What are some of the costs?
      (1) manpower
      (2) resources
      (3) depreciation of equipment.
   c. How would employment be affected? (If too costly, will operation close?)
5. What can students do?
   a. Conserve heat and light.
   b. Use car pools and bus rather than drive to school alone, walk, ride a bike, etc.
   c. Enjoy the out of doors, instead of television.

See the article, "The Scramble for Resources," *Business Week*, June 30, 1973, page 56.

ACTIVITY D: LONGEVITY OF PRODUCTS

1. Choose several mechanical devices at random. Several groups can make lists and work on them in free time.
2. Check how long they usually last. Take a poll; find persons who have some of the items on your list. Do they replace these items often? Why?
3. Compare the lists. Itemize the devices according to type:
   a. transportation
   b. appliance
   c. heat or light
   d. other
4. Do the times of usefulness seem comparable for like devices? Why? Why not? Do the users have any effect on longevity? Why? How could additional technology encourage longevity? Why? How could you take an active part in making things last longer?
   a. Learn to repair appliances and plumbing.
   b. Learn operations of transportation vehicles to keep them repaired and serviced yourself.
   c. Learn to conserve use of devices by planning wisely.
5. See the article, "The Push To Get More From Men And Machines," *Business Week*, September 9, 1972, page 79.

ACTIVITY E: LOOK HOMEWARD

1. What does the statement "Less Consumer Push for Electric Products" mean to you? Your neighbors?
2. Make a list of the electrical appliances and uses in your home. List in categories: (1) appliance, (2) necessary equipment, (3) accessory.
3. Make up an inventory list that you can use to ask members in your community about electrical uses in their homes.

   Make up an inventory list to poll members of the community (walking on sidewalks, in front of a store, or at a place of business). Be sure to inform parents and administration that this is being done.
4. Discuss your personal lists in comparison to the lists of neighbors (members of community).
   a. List essentials and non-essentials.
   b. Are there noticeable differences? Why?
   c. Do you think the public is taking the statement above seriously? Why? Why not?
5. Make suggestions concerning the attitudes for buying and what you can do about them. Look at yourself and at the demands you make.

ACTIVITY F: LESS PREPACKAGING AND PREPARED PRODUCTS, LESS THROW AWAY

1. Watch a checkout counter in a grocery store for 10-20 minutes. (Be sure the clerk, manager, or both are aware that student is taking a poll.)

2. As you watch, list the prepackaged items and prepared foods in packed containers. Compare at least five customers.
   a. List paper packages
   b. Metal packages
   c. Plastic packages
   d. Other
3. Arrange or organize types of prepackaged food most often purchased in columns or in a check list pattern. Use this as an inventory sheet.
4. Question neighbors about prepackaged items:
   a. Which would/could they buy without packaging?
   b. Why do they buy prepackaged items?
   c. Do the elderly shoppers buy prepackaged and prepared foods?
5. Compare polls and answers for buying prepackaged and prepared items.
   a. Is the consumer aware of products that are available without packaging?
   b. Do you think he would do things differently?

APPENDIX A:
STEPS IN TAKING AN INVENTORY

In taking an inventory, the teacher must consider the particular group that is participating in the activity and their experience. An inventory may be attempted by a whole class or by small groups on a given topic.

Identifying a topic may be accomplished by indirect motivations in establishing an idea, or from a suggestion such as a picture or an odor. A simple list of nouns mentioned by class members can be the beginning of an inventory. Groups or individuals will volunteer or be assigned the nouns suggested.

With a list of things to investigate, the students become aware of their topics in a different, more realistic way. They begin to ask questions and find that they, as students, are limited in their knowledge or awareness of things.

Comparing information and realizing that others may find that they, too, are limited is a valuable lesson. Tension between students may develop; this is desirable because it shows concern and enthusiasm. The discussions must be controlled only in the sense that inappropriate action toward other individuals cannot be allowed.

Judgements can be made from the feelings that have arisen about the material gathered. Things are seen in a different perspective, if the student has become truly aware. If he has not, the experience is still a learning one.

After their initial exposure to interaction, the members of the group will feel more comfortable in that situation, and the other activities will provide an opportunity for growth in this area.

The teacher should notify the parents of the students who are doing inventories and encourage their participation. Parents should be aware that their children may be speaking to strangers.

The teacher should be especially attentive to safety practices and allow no exceptions to rules affecting the safety of individuals.

In taking an inventory, these skills can be developed:
- to observe - become aware
- to describe - written or oral
- to locate - in time; geographically
- to define - academically; morally
- to relate - cause; effect

Working on projects as a class, in small groups, or individually will allow the students to develop attitudes toward:
- Rights
- Privileges
- Obligations
- Responsibilities

APPENDIX B:
INFORMATION ON NATURAL INVENTORIES

The basic ecosystem is an interacting unit. This unit is made up of plants and animals and their relationships with one another and with the non-living factors of the area, such as sunlight, soil, and weather.

1. The sun is the ultimate energy source of all life.
2. $6H_2O + 6CO_2 \xrightarrow{\text{Sunlight}} C_6H_{12}O_6 + 6O_2$

   Water — Carbon Dioxide — Chlorophyll — Glucose — Oxygen

   Since green plants contain chlorophyll, they are called producers. They produce a usable energy, called glucose, out of the sunlight, water, and carbon dioxide. This process is called photosynthesis.
3. Animals that eat only green plants or their fruits are called first level consumers. A few examples of these are cows, rabbits, woodchucks, squirrels, and mice.
4. Animals that eat these animals are called second level consumers or predators. Some examples of these are cats, foxes, hawks, and man.

Therefore, in any area of the world that supports life, a basic food chain of "who eats whom" can be discovered. If the soil is rich in nutrient and organic matter and the weather is favorable, many life forms will be discovered. Since the amount of water available, the amount of sunlight, the temperature, and the types of soils are not the same throughout your community, you will notice that each area in your community will support different types of life forms. These non-living materials are called limiting factors, because of the effects on life forms they make. The different areas in your community where wildlife can be found are called habitats.

APPENDIX C:
EVALUATION OF INVENTORIES

Subjective Grade

1. *Group Grade* — This grade is an evaluation by each team member of every other member's work. This will help to insure equal student participation. Any evaluation should be followed up with the reasons for it.
2. *Individual grade* — Each student will evaluate himself or herself upon the work he or she has done in comparison to what he or she could have done. Reasons for the evaluation should be stated.
3. *Class grade* — All members of the class evaluate the presentation based upon the goals, objectives, organization and procedures of the inquiry.
4. *Teacher grade* — Based upon the planning and organization of the chosen inventory, and upon the presentation of material, written report, and participation in the discussion of the report and completed inventory.

APPENDIX D: CLASS EVALUATION

Group Graded_____

Evaluator_____

Consider the following factors in evaluating your classmates' performance in their presentation.

1. Goal: Was the goal met? Were the objectives clear and concise? Do the objectives answer the basic question?
2. Organization: Is the material stated clearly? Did you understand it?
3. Facts: Are the students knowledgeable concerning their research topic? Do their facts support the goal?
4. Time usage: Did the project require two weeks work? More or less? What limitations were met? What did the group do to get around their problems?
5. Presentation: Did you learn something from it? How interesting was it?
6. Resources (literature and community): Were resources used to best advantage?
7. Procedure or Method: How valid was it? Do you have any suggestions? Was it followed through in a logical sequence? Did it show efficient use of time and energy?
8. Hypothesis: Is it based on facts? Was it tested?
9. Conclusion or action taken.
10. Spin-off questions: Do questions show thinking on the part of the group?

Student input or comment:

Self-Evaluating My Project

1. Have I reached my goals?
2. How clear and concise were my objectives?
3. Did I learn something new and increase my awareness?
4. Was the experience interesting and worthwhile?
5. Was there interest and cooperation shown by my group and/or community?
6. Did I have an opportunity to carry out my plans and use my own ideas?
7. Did I gain satisfaction and pride through this experience?
8. Were time and effort well spent by doing this experience?
9. Will this experience benefit me in the future?
10. Approximate hours I spent on this project ____

APPENDIX E: SOME POSSIBLE MEANS OF EVALUATION

Teacher:

1. Display all charts, projects, bulletin boards, reports, studies, etc.
2. Make up an objective test to define terms; include two thought provoking questions.
3. Refer to an experience (a motivating procedure) that took place in the classroom and have the students write the steps taken in the project. (Making a terrarium, fog, etc.)

Pupil:

Name _____ Class _____

1. What was your project? _____
2. What was the goal in this project? _____
3. How did you decide on your goal? _____
4. Did you attain your goal? _____
5. Did you work in a group or by yourself? _____
6. Why did you choose to do the project this way? _____

_____

7. Would you say that this was a valuable learning experience?

   Briefly explain your answer _____

_____

_____

APPENDIX F: TYPICAL LIFE FORMS OF COMMUNITIES

1. *Grasslands, Fields, Meadows*
   Producers
   grasses, brush, small trees
   weeds
   crops, gardens
   First Level Consumers
   arthropoda, insects
   birds
   small mammals, rats, rabbits, wood chucks, livestock, sheep, cows, pigs.
   Second Level Consumers
   foxes
   raccoons
   dogs
   cats
   hawks
   owls
2. *Forest, Woodlots, Brushy Areas*
   Producers
   grasses
   trees: beech, maple, oak, hickory
   First Level Consumers
   squirrels, chipmunks
   ruffled grouse
   wood chucks
   raccoons
   Second Level Consumers
   foxes, dogs, cats, hawks, owls
   Scavengers
   opossums, crows, skunks
3. *Bogs, Swamps, Marshes*
   Producers
   algae, spirogyra
   sphagnum moss
   grasses, sedges
   bulrushes
   cattails
   reeds
   trees: willow, poplar, dogwood
   First Level Consumers
   aquatic and semi-aquatic insects, waterfowl, deer
   Second Level Consumers
   fish: panfish, bass-pickerel
   amphibians, frogs
   reptiles: turles, snakes
   foxes, hawks
4. *Stream, Lake, Rivers*
   Producers
   algae-plankton
   duckweed
   emergent vegetation, lily pads
   First Level Consumers
   aquatic insects
   crustecea, rotifers
   dragonfly nymphs
   hydra
   Second Level Consumers
   bass, pike, perch, panfish, trout
   turles and snakes
   hawks, osprey
   raccoons
   Scavengers
   annelids, planaria, blood worms
   midges
   catfish, suckers, carp
5. *Ponds, Lakes, Reservoirs*

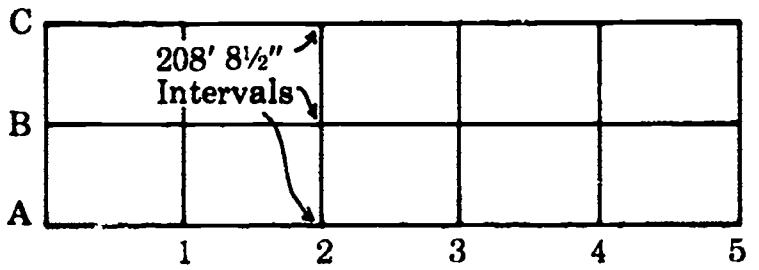
APPENDIX G: HOW TO LAY OUT THE GRID

An acre can be plotted by measuring out a square of 208 feet, 8½ inches. Locate your base line from the farthest point that will allow you tc closely investigate a specific community. Mark this point well and as permanently as possible, so that students can become proficient in plotting an acre.

Once you have your starting point, run a straight compass line and mark off 208′ intervals. In good terrain, the intervals can be paced, but measuring by steel tape or rope is more accurate. In thick cover, send a man ahead with a colored stake and keep him on the line through the compass sights as long as you can see his stake. When he has driven in the stake, move up to it and send him on ahead again. In some places, you may have to sight his stake as he holds it over his head or sight below the intervening shrubbery by lying on the ground yourself.

If the cover is dense and brushy, it may be necessary to cut a narrow sighting lane through it. Such cutting has a negligible effect on the environment, and you will need this lane later, for walking the line when making a census.

When you have measured off the first 208′ interval, put in a stake, mark a tree or otherwise fix this, your second corner. Keep marking the intervals until you come to the boundary opposite the one on which you started or until you have gone as far in that direction as you wish your grid to extend. Then run similar lines out at right angles at each of your 208′ corners, and your grid is established.



This representative grid would cover 10 acres. The grid lines should be inked in. All other lines or field notes are pencil notations. An acre is a convenient area to use in a rural community, but not in an urban or suburban community, although this method of developing a grid seems to be valuable whether the area in concern is large or small.

Many animal activities symbols can be developed and plotted on your data grid sheet. These might be things like tracks, burrows, direct observations, or calls.

This would be a good time to stress the importance of keeping a permanent record. This is called a journal and is made up of three major sections. Record all daily data in the first section; this is the log. Put all original ideas, thoughts or fears in the next section. It is termed the input section. The last section can be divided into two parts: community and library resources. This would be a list of people seen and books and magazines used.

APPENDIX H: AREAS OF CONCERN

1. *Parents:* Parents should become involved early in the course, because they are valuable resources. An early meeting with them could prove helpful. Also, bi-monthly progress reports of student activities would keep them informed of the types of projects being researched. Parents should have a complete understanding of what their child is doing before permission is given for them to leave school or home for research of any kind.
2. *Research Safety:* Safety is a value that must be stressed throughout the whole program. A major mishap could put an end to this program before it gets off the ground. First aid kits should be readily accessible in the laboratory or room, as well as out in the field. Water safety should be understood before stream inventorying takes place. Sterilization and non-contamination techniques will be the first lesson in working with bacteria and all stream water samples.
3. *Equipment:* Tools needed in research should be developed, if at all possible, by the students themselves. This alone deepens the students' involvement in his investigation and allows for a great degree of creativity. This may take a lot of guidance and patience on the part of the teacher and a great deal of inquiry on the part of the student.
4. *Recognition:* Material class goals should be established in the beginning of the unit. One goal could be a bound book of all the inventories taken and the procedures and methods used during the use of this unit. Copies could be distributed to concerned people, for example, the mayor, town council, land use planning committee, school library, school administration, and concerned community resources.

   The class could display their project work in a school science fair. Projects could be sent to the Ohio Academy of Science for recognition. The school could be enrolled in the President's Environmental Merit Awards Program, "Life: Pass It On."

REFERENCES:

TEACHER AND STUDENT BOOKS:

American Public Health Association. *Standard Methods for the Examination of Water and Wastewater.* New York: 1965.

Andrewartha, H. G. *Introduction to the Study of Animal Population.* Chicago: Phoenix Books, The University of Chicago Press, 1965.

Beck, Alan M. *The Ecology of Stray Dogs.* Baltimore: Maryland, York Press Publishers, 1973.

Benton and Werner. *Manual of Field Biology and Ecology,* 5th Edition. New York, N.Y.: McGraw-Hill, n d.

Collins, H. H. *Complete Field Guide to American Wildlife.* New York: Harper & Brothers, 1959.

DeBell, Garrett. *The Environmental Handbook.* New York: Ballantine Books, Inc., 1970.

Flanders, David. *Circle of the World.* New York: Benziger, Inc., 1971.

Gorman, Rena. *Air Pollution Primer.* New York: National Tuberculosis and Respiratory Disease Association, 1969.

Institute for Environmental Education. *Water Pollution and Environmental Studies,* Volume I. Cleveland Heights, Ohio: Office of Water Programs; 1971.

Kormondy, Edward J. *Concepts of Ecology* New Jersey: Prentice-Hall, 1969.

Martin, Nelson, Zim. American Wildlife & Plants: *A Guide to Wildlife Food Habits.* New York: Dover Publications, Inc., 1951.

Needham and Needham. *Guide to the Study of Fresh Water Organisms.* San Francisco, California: Holden Day, n.d.

Odum, E. P. *Fundamentals of Ecology.* Philadelphia, Pa.: W. T. Saunders Co., n.d.

Smith, Robert L. *Ecology and Field Biology.* New York: Harper and Row Inc., 1966.

Terry, Mark. *Teaching for Survival.* New York: Ballantine Books, Inc., 1971.

PERIODICALS:

"Environmental Education," *Instructor,* January, 1971.

"Outdoor Classrooms: On School Sites," *U.S. Department of Agriculture: Soil Conservation Service.*

Pough, Richard, "How to Take a Bird Census," *Audobon Magazine,* Volume 49, 1947.

"Productivity: Our Biggest Undeveloped Resource," *Business Week* (Special Issue), Number 2245 (September, 1972), pages 79 to 97.

"The Scramble for Resources," *Business Week* (Special Report) Number 2286, (June, 1973), pages 56 to 63.

"The Trade-offs for a Better Environment," *Business Week* (Special Report), Number 2219 (April, 1970), pages 63 to 78.

TEACHER'S NOTES:

ENVIRONMENTAL MANAGEMENT

The purpose of this unit is to identify the procedures which are used to monitor, control, and change environmental conditions. Although most management is a result of the work of highly organized and funded agencies, the emphasis within this unit will be on the impact that an individual or group of individuals can have on this management if they are aware and concerned.

Governments, industries, and private organizations have developed numerous programs designed to help manage our environment. Some are effective, some are not. Many are repetitious and of little consequence. It is the purpose of this unit to investigate what these agencies are, how they are structured, and how they are able to influence environmental conditions. It is not the intent, though, only to look at these agencies and their efforts, but also to focus on the individual and his role in, and responsibilities for, the management of his environment.

This unit is designed to promote a better understanding of the environmental management process, using air pollution as an example and as a basis for discussion. Air pollution is used as our basis for discussion because the industrial nature of Ohio lends itself well to this concern. The United States Public Health Service has included six Ohio metropolitan areas among the top twenty-five in the country having the greatest degree of air pollution (1967).

This data is available and can be used as a basis for a comparative study of the effectiveness of pollution control agencies. It would be hoped that the pollution problems of other states be also surveyed (Arizona, New Mexico, Wyoming, etc.) to show that they also have problems particular to their area.

There is a tremendous amount of information available relating to environmental management, but it is recommended that this information be procured before beginning the unit. (See Appendix.)

Equipment and supplies for this unit can be kept very simple and inexpensive. Certainly, though, if very sophisticated results are desired, advanced techniques and equipment will be necessary.

This unit lends itself well to an urban and suburban area as an action type of experience, but it has its limitations in a rural area and could probably be used as a model study. In the rural area, the emphasis would be on the idea that "No Man is an Island." Air travels, and what happens over an industrial area does affect the quality of rural air to some degree. Rural students may be better able to adapt Experience #4 to their particular area.

INSTRUCTIONAL OBJECTIVES:

At the conclusion of this unit, the student will:

1. Develop an awareness of the services available within his community, state, and nation that deals with environmental problems.
2. Determine what pollution monitoring devices are being used within his community and whether they are appropriate to a realistic and valid interpretation of environmental conditions.
3. Identify the various ways in which the processes of management and technology are used in an individual's environment.
4. Identify the scope of various types of pollution.
5. Effectively research questions that are encountered while studying pollution.
6. Collect background information that is relevant to an understanding of pollution.
7. Obtain data of actual situations that involve air pollution emissions.
8. Define the influences which various agencies have in relation to the control and analysis of environmental conditions.
9. Develop easily used and reliable techniques that will be utilized to assess the quality of air from different sources and under different conditions.
10. Resolve his own personal position and attitudes on environmental management.

CONTRIBUTORS OF THE DEVELOPMENT OF THIS UNIT

Authors ..... Alan Wolf
Ronald A. Wolfe
Editor ..... Stoyan N. Topalof
Revisor ..... Charles Cuthbert

TABLE OF CONTENTS

EXPERIENCE #1: IDENTIFICATION OF MANAGEMENT PROCESS

OBJECTIVES:

At the conclusion of this experience, the student will be able to

1. Develop his/her awareness of the air pollution level.
2. Construct a glossary of terms which are relevant to a study of environmental management.
3. Describe the structure, function, and development of the Ohio Environmental Protection Agency, and other environmental protection agencies.
4. Use a map of his/her community to locate different pollution problems, using appropriate symbols.
5. Calculate a residential pollution index for an area by using information about the population and types of polluting structures.
6. Identify sources of air pollution and the air contaminants contained in the polluted air.
7. Assimilate and communicate any data collected.
8. Better understand the reactions involved in the combustion of common materials.

ACTIVITY A: GETTING STARTED

The following sample questions have been selected to be given to the students in order for each student to determine his own relative awareness of the atmosphere and the problems associated with it. The questions are not intended to be judged by anyone other than the student himself. It is hoped that the student will be able to assess his own knowledge of the atmosphere. The statements listed below are all true statements. The student would be asked to respond to these statements as being true or false. The test should be administered at the beginning of the unit.

Sample Questions:

1. Nitrogen and oxygen normally make up about 99% of the air.
2. Transportation is the major cause of atmospheric pollution.
3. Air pollution is usually worse in the winter time than it is in the summer time.
4. The Environmental Protection Agency is primarily responsible for setting standards and controlling air pollution in Ohio.
5. Almost all controls of air pollution sampling are limited to stationary sources.
6. As the CO^2 content of the atmosphere changes, so does the earth's average temperature.
7. Weather conditions have a great deal to do with how much pollution we see.
8. Smog is a mixture of smoke and fog.
9. The EPA is not the only group concerned with our air pollution.
10. Even if we had no automobiles, we would still have some air pollution.

ACTIVITY B: GLOSSARY OF TERMS

The glossary of terms is introduced here in case the student is developing a notebook related to this unit and to serve as a basis for building an environmentally oriented vocabulary. It is in no way complete and should be modified to fit the needs of the student.

compliance	violation
variance	assessment
sulfur dioxide	process
nitrogen dioxide	emission
hydrocarbon	Ringelman scale
particulate	filter
plume	source
contaminant	pollutant
carbon dioxide	atmosphere
management	fog
standards	smog
technology	carbon monoxide

ACTIVITY C: OHIO ENVIRONMENTAL PROTECTION AGENCY

Teacher's Note:

Materials from EPA should be available at the start of the activity. Along with the distribution and discussion of EPA materials, the following facts should be highlighted:

1. *In 1971 the Citizen's Task Force on Environmental Protection, under the direction of John Glenn, made a statewide study of the environment.*
2. *The Ohio EPA was created by the state legislature on October 23, 1972.*
3. *The Ohio EPA was preceded by the Ohio Water Pollution Control Board and the Ohio Air Pollution Control Board. Both of these agencies operated with only part-time members while the Ohio EPA uses primarily full-time members.*
4. *The Ohio EPA director administers 60,000 to 90,000 air pollution permits and 2,000 water pollution permits.*
5. *All potential sources of air and water pollution are under the authority of the Ohio EPA.*
6. *The Ohio EPA grants permits for sources that meet current standards, permits for sources allowing variances to the standards while working toward meeting these standards, and construction permits for potential new sources.*
7. *The Ohio EPA may levy fines of up to $10,000 per day to violators of air and water pollution laws.*
8. *In addition to laws concerning air and water pollution, the Ohio EPA also has authority over laws on solid waste disposal standards, water planning and development, supervision of sewage treatment, and public water supply.*

The Ohio EPA encourages individual involvement. Students with a special concern or problem may contact the Ohio EPA on a toll free number, 1-800 282-0270. They might also contact any of the district offices in Cuyahoga Falls, Bowling Green, Nelsonville, and Dayton.

See appendix for additional EPA material that is available.

Discuss these questions:

1. Is there a need for a statewide environmental management agency? Why? Why not?
2. How could a person judge the effectiveness of the Ohio EPA? Establish criteria.
3. Develop an alternative to the Ohio EPA.

ACTIVITY D: MAP OF COMMUNITY

To gain a greater understanding of the management process, it is often helpful to see the various locations of polluters within a given community. Students can make large scale maps of their local area or of the area that would have an influence on the air they breathe. Maps can be drawn or purchased from the city or town hall, or road maps from service stations can be utilized. After developing the map, students can locate various sources of pollution and sampling points. These maps will be utilized in later activities.

ACTIVITY E: WHERE ARE WE NOW?

In 1967 the United States Public Health Service ranked 65 metropolitan areas with an industrial population of over 40,000 in order of their degree of air pollution. The ranking system had New York City with the highest number: 457.5. The lowest was the combined area of the cities of High Point and Greensboro, with a number of 87. Students could make a large map of the state and locate the eight Ohio cities which were included. They might also locate their own community in order to see its proximity to the eight cities.

The rating of the eight Ohio cities was as follows:

Standard Metropolitan Area	Rank (out of 65)	Rank Sum
Cleveland	5	390.5
Akron	12	367.5
Cincinnati	19	325.5
Canton	22	302.0
Youngstown-Warren	23	294.5
Toledo	24	287.0
Dayton	26	280.0
Columbus	46	231.5

The rating system which was established by the Public Health Service was not meant to be extremely objective, as the precise data might indicate, but rather to provide some relative information about some major cities in the United States. Of the 65 cities studied, eight are included in the state of Ohio. Six of the eight were ranked in the first 25.

The above data is to be used as a basis for discussion that will lead to the student finding how we rank presently and how we have ranked in past years. This should lead to a "why" type discussion. Why are we ranked where we are, etc.?

ACTIVITY F: RESIDENTIAL POLLUTION INDEX

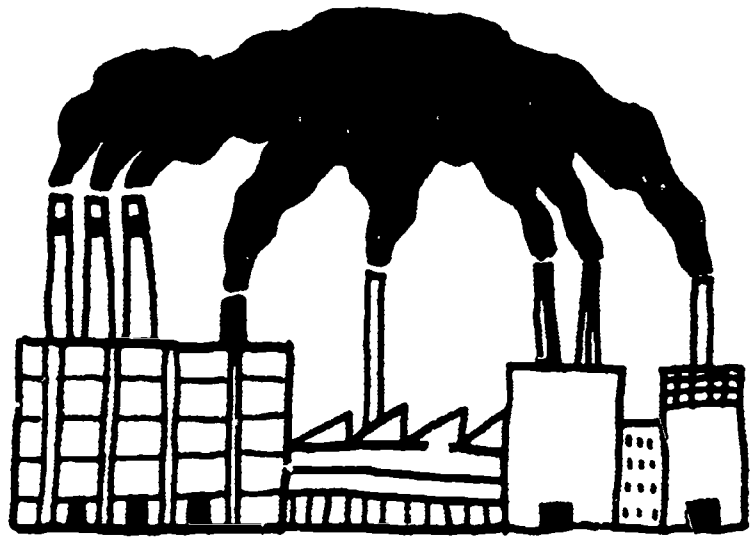
The management of air pollution is usually located at the industrial and business sites of our larger cities. This exercise is an assessment of residential areas for the purpose of investigating management on an individual level. Each student is to survey his own street or road. Each household would be given an index number based upon its creation of pollution. The index would be determined by the compilation of the following numbers:

For each regularly used fireplace .....7 points
For each regularly used incinerator.....9 point
For each coal or oil furnace.....6 points
For each gas furnace .....5 points
For each electric furnace.....4 points

The index numbers have been chosen very subjectively and the variation in numbers is used to show a relative scale of pollutants. Variations in usage may be considered by either adding or subtracting from the individual index numbers. The student could determine an index number for each house on the street by adding all of the index numbers which apply to the individual household. Every one hundred yards, all of the household index numbers would be added together. An index number would then be determined for every one hundred yards of street. A street map could be made and the index plotted by using a different color for different levels of pollution. A recommended color variation could be the following:

1. Red .....over 250
2. Orange.....over 200
3. Yellow.....over 150
4. Green .....over 100
5. Blue.....over 50
6. White .....less than 50

An additional activity could be developed by the students by surveying the automobiles owned: type, number, year, miles driven, type of driving (turnpike vs. town), etc. This would give them an opportunity to realize what an index is.



ACTIVITY G:
AIR CONTAMINANTS

To better understand the role of various agencies in managing the environment, students should understand the types and kinds of information which they assess and the ways in which they might present this to the public.

In 1968, the Department of Health, Education, and Welfare published the national concentrations of various pollutants with respect to all other pollutants. These results are as follows:

Carbon monoxide	47%
Hydrocarbons	15%
Particulates	13%
Nitrogen oxides	10%
Sulfur oxides	15%

This data changes periodically but usually not to a great extent.

Students may be given a list of the five materials, and then discuss what they are, how they are structured, and where they come from. Students should also discuss what percent of each they think is found in the air. Have them construct bar, line, or circle graphs and then compare these with the above data. All of the students could then see a graphic example of what the pollutants are and be better informed in making value judgements about the management of their sources.

If a further study of what pollutants may be in the air is desired, a discussion of the following data may be undertaken:

Many atmospheric pollutants are the result of the combustion of a few chemical compounds and elements. The reactions of some common compounds are easy enough for most students to write and balance. These chemical equations could be used as an individual lesson on balancing equations and writing equations.

Material of Combustion	**Reaction**
Acetylene	$2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$
Carbon (to CO)	$2C + 2O_2 \rightarrow 2CO_2$
Carbon (to CO_2)	$C + O_2 \rightarrow CO_2$
Carbon Monoxide	$2CO + O_2 \rightarrow 2CO_2$
Ethane	$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$
Ethylene	$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$
Hydrogen	$2H_2 + O_2 \rightarrow 2H_2O$
Hydrogen Sulfide	$2H_2S + 3O_2 \rightarrow 2SO_2 + 2H_2O$
Methane	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
Sulfur (to SO_2)	$S + O_2 \rightarrow SO_2$
Sulfur (to SO_3)	$2S + 3O_2 \cdot\cdot 2SO_3$

ACTIVITY H:
SOURCES OF CONTAMINANTS

Teacher's Note:
In environmental management, the sources of contaminants are as important as the kinds of pollutants being produced. In discussion of management policies, students should be aware of some of these sources. This awareness will be instrumental in making decisions about possible alternatives.

The Department of Health, Education, and Welfare (National Air Pollution Control Administration) has produced data which show the amounts of polluting sources by percent. This was done in 1968, but the values are about the same: (If possible, have the percentages updated in this activity for comparative purposes.)

Transportation	42%
Fuel Combustion Stationary Sources	21%
Industrial Processes	14%
Solid Waste Disposal	5%
Forest Fires	8%
Miscellaneous	10%

Students can represent this data in a variety of ways. Circle graphs and bar graphs are two of the best known methods.

The same approach may be used here as was outlined in Activity G. Have the material presented, have students "guess" percents, and then look at actual data.

EXPERIENCE #2: DATA RETRIEVAL

OBJECTIVES:

At the conclusion of this experience, the student will be able to:

1. Determine the quality of smoke coming from a smokestack by using the Ringelman scale.
2. Use a sling psychrometer, calculate relative humidity, and realize why relative humidity varies.
3. Collect particulate matter from the air and other sources, make comparisons, and calculate degrees of pollution.

ACTIVITY A: RINGELMAN SCALE

The Ringelman Scale was first introduced to this country on November 11, 1897. Since its introduction it has been used as a primary device for the detection of air pollution emissions. The chart is based upon the density or darkness of smoke coming from any source. It was developed by a university professor, Maximilian Ringelman, in Paris, France. Before its use in this country, it was used extensively throughout Europe. After its introduction in the United States, it was used by the United States Geological Survey. Its present use is quite extensive, and trained individuals can determine whether the density of smoke which is determined by colors on a chart is within permissible standards.

The results obtained from the Ringelman Scale have been shown to be reliable. However, there are often factors which influence the color, such as the amount and direction of the sunlight. To use the charts, observers should stand at a distance from the charts so that the charts merge into shades of gray. When recording the smoke density, the time and date of all observations should be made. Average smoke emission can be determined by making several observations over an interval of time (15 seconds). adding them together, and dividing by the number of observations.

Ringelman charts may be obtained free from

Publications Distribution Branch
Bureau of Mines
4800 Forbes Avenue
Pittsburgh, Pennsylvania 15213
or
Air Conservation Committee
4614 Prospect Avenue
Cleveland, Ohio 44103

Students may also make an approximate Ringelman scale in the following fashion: the chart uses shades of gray that are reproduced on five different cards. Each card represents a uniform increase in shading. If students are making their own cards, they will need six cards, a metric ruler, and a dark pencil. The cards would be drawn as follows:

Percent of black	Card number	Directions
0	0	Completely white.
20	1	Black lines are 1 mm thick, 10 mm apart, leaving white spaces 9 mm square.
40	2	Black lines are 2.3 mm thick, spaces are 7.7 mm square.
60	3	Lines are 3.7 mm thick, spaces are 6.3 mm square
80	4	Lines are 5.5 mm thick, spaces are 4.5 mm square.
100	5	Completely black.

Cards should be 21 spaces in length and 14 spaces in width.

Variations in the observations could be made as follows:
1. Charting of stacks over a period of days.
2. Comparison of different days.
3. Comparison of sunny and shady days.

Materials:
1. Ringelman Chart
2. Cards.

ACTIVITY B: THE SLING PSYCHROMETER

A sling psychrometer or hygrometer measures the temperatures of a thermometer which is dry and of one which has its bulb wrapped in wet cotton. The evaporation of the water in the air will cause the thermometers to be cooled when they are swung. Greater amounts of water vapor in the air will cause greater decreases in the temperature. The wet bulb will have a concentrated amount of water in the cotton ball wrapped around its bulb. A comparison of these two temperatures shows the relative humidity. Directions for the interpretation are given in the next activity on relative humidity.

Commercially made psychrometers are available through Hubbard Scientific and are relatively inexpensive. Psychrometers can be very useful in determining the relative humidity in the atmosphere. The amount of water which the air can hold is dependent upon the temperature. The higher the temperature, the greater the amount of water the air can hold. Air at a temperature of 86° F will be able to hold 30.4 grams per cubic meter of water vapor at 100% humidity, while at a temperature of 68° F, the air will be able to hold only 17.3 grams of water vapor.

ACTIVITY C: RELATIVE HUMIDITY

In order to interpret the relative humidity from the wet and dry bulb temperatures, the two temperatures are compared on a chart which is produced in many science textbooks and resource books. Students may reproduce one of the textbook charts on a larger scale and display it on the wall for all to use as a reference.

An example of some values found on a relative humidity chart would be as follows:

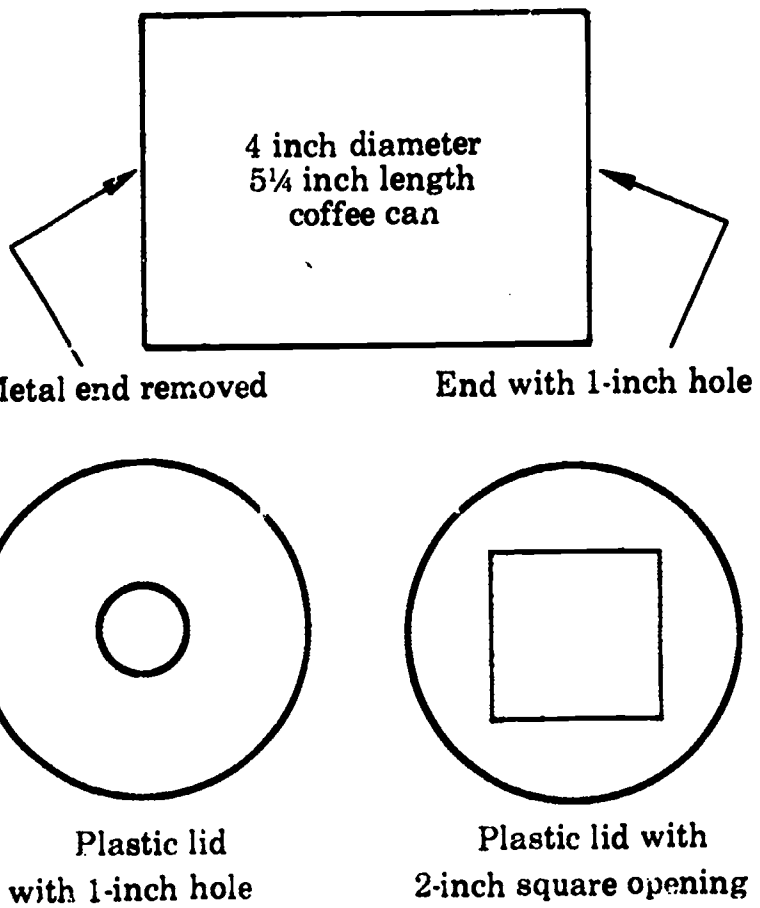
Temperature of dry bulb in °F	Temperature of wet bulb in °F											
	63	62	61	60	59	58	57	56	55	54	53	52
	Relative Humidity (percent)											
64	95	89	84	79	74	70	65	60	56	51	47	43
65	90	85	80	75	70	65	61	56	52	48	44	39
66	85	80	75	71	66	61	57	53	49	45	40	36
67	80	76	71	66	62	58	53	49	45	41	37	33
68	76	71	67	63	58	54	50	46	42	38	34	31
69	72	67	63	59	55	51	47	43	39	35	32	28
70	68	64	60	55	52	48	44	40	36	33	29	25
71	64	60	56	52	48	45	41	37	33	30	27	23

In addition to determining the relative humidity, students might also compare their daily results with the results that are reported on daily weather reports. Graphs could be made of data over a period of days.

ACTIVITY D: MOBILE SOURCES OF AIR POLLUTION

Many of the managing and controlling agencies for air pollution consider variations in the amount of pollutants from stationary sources only. From data, it seems that more air pollution comes from mobile sources, and consequently it follows that there should be greater management of cars, trucks, buses, trains, and planes. The purpose of this activity is to manufacture a device for the collection of particulates from automobiles. Most plans for this kind of sampler recommend the use of vacuum cleaner hoses. The diagram below describes a sampler which is made from a coffee can and two plastic lids.

PARTICULATE SAMPLER FOR A MOBILE SOURCE



Filter paper is used to collect particles from automotive exhaust. The exhaust pipe should be wedged into the one-inch hole in the plastic lid which is placed over the open end of the can. A one-inch hole should be drilled into the metal end of the can. This end is covered with filter paper and a plastic lid which has a two-inch square cut in it. Various material may be used for filters (coffee filters, toilet tissue, etc.), but commercially made filters are recommended because of their small pore opening. If the filter paper is larger than the diameter of the can opening, it can be held in place by the plastic lid. Smaller filters can be taped over the opening.

Variations in the collection of samples might include these:

1. Tests done on different cars.
2. Tests for different lengths of time.
3. Comparison of 4 vs. 6 vs. 8 cylinder cars.
4. Comparison of different types of gasoline.
5. Test under different conditions, i.e., warm vs. cold car.

The filters can be compared by the darkness of the sample collected. The Ringelman Scale can be used to provide a more quantitative analysis.

ACTIVITY E: PARTICULATE COLLECTION

Most students seem to be more comfortable with experiments in which they can see immediate results. For this experiment students can collect particulate matter in various locations. A glass slide, coated with a substance such as petroleum jelly, will collect particulate matter settling out of the air. Notecards may be used in place of the glass slides. The larger glass slides, which are available from some suppliers, are the most useful. After the collection of the sample, they may be used for microscopic examination. Also, if a heavy weight oil, such as that used for an oil immersion lens, is available, the results will be much better. After coating the slides with the oil, students can expose them to various areas in their community. Students could take samples from around the outsides of their individual homes and bring them to school for microscopic examination. They could present their data by counting the number of particulates and also by drawing some of the particulates and speculating upon what

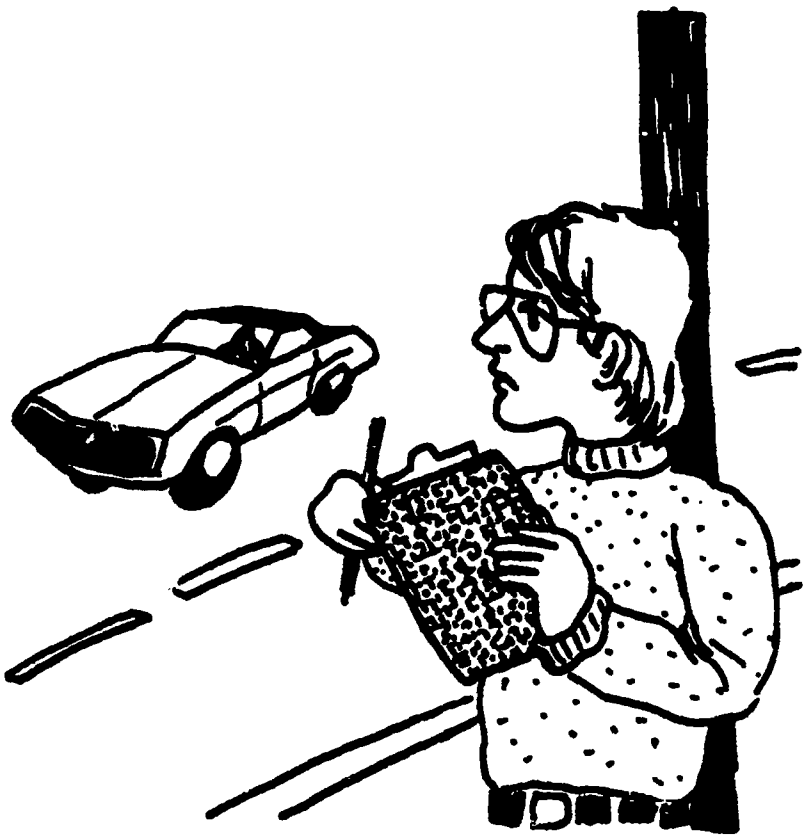
they might be. There may be dust, carbon, crystals, plant materials, or a number of other things.

Questions for analysis might include these:

1. Is there a difference between sampling done during the day and during the night? or during different seasons? or during different days of the week?
2. How does the data compare to the daily air pollution index?

Materials:

1. petroleum jelly
2. glass slides (or notecards)



ACTIVITY F: TRAFFIC SURVEY

Most of the managing devices for air pollution are limited to emissions from stationary sources. One of the major causes of air pollution is the automobile, whose pollution is usually controlled only before production. For this activity, the students would assess car-truck frequency at various points in the community. The effect of their frequency would then be discussed.

Additional activities for survey could include these:

1. Recording of times when traffic is at a maximum or at a minimum.
2. Duplicating a map which shows streets and roads open to truck traffic (available from city hall).
3. Locating on a city map parking lots and other areas which might show traffic congestion.
4. Surveying the types of cars, such as compacts vs. full-size cars.
5. Determining and graphing the results of the number of passengers per car, which would have a profound effect upon rush-hour traffic.

EXPERIENCE #3: ANALYSIS OF SYSTEMS EFFECTIVENESS

OBJECTIVES:

At the conclusion of this unit, the student will be able to

1. List pollution management problems in an industrial area after making personal observations.
2. Chart the air pollution index in graph form after collecting data as reported on television or in the daily newspaper.
3. Contact local industries and report on pollution programs which are being used by each industry.
4. Participate in a simulation which describes a local air pollution management decision.

ACTIVITY A: TOURING AN INDUSTRIAL AREA

Although the state of Ohio is known for its fine farms and history of agriculture, it is also noted for its development of industry and the problems associated with it. Almost every area in the state has ready accessibility to an industry. A trip to one of these industries can be most profitable and interesting to the study of environmental management. Most of the industries can be observed from the outside, but some of the specific ones will also permit student tours. In the Cleveland area, the Air Conservation Committee has prepared a special map for a self-guided tour. Other areas in the state might use this map as a model for touring their own industrial areas. For very specific information, the *Air Pollution Engineering Manual* (U.S.EPA) can be used.

Students can map the area and locate the various industries. These are representative industries in the state:

Steel Manufacturing: These are very good industries for seeing large quantities of smoke. The gases coming from the stacks often exhibit a variation in color and amount. Before observing, students should research some of the things they will see, such as scarfing, sintering, blast furnaces, basic oxygen furnaces, and coke ovens. The coke ovens are usually quite dramatic, especially when water is used to cool the coke. This causes large clouds of smoke loaded with particulate matter and steam, which often result in a very localized rain.

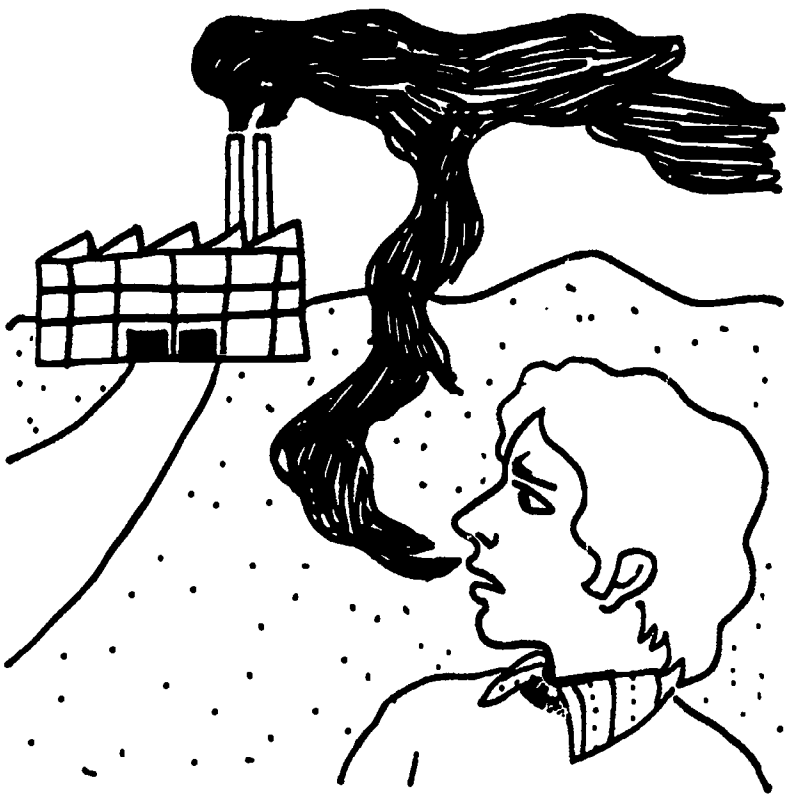
Power Plants: These are also very good sources for observation. Research should be done on the operation, fuel used, and pollutants produced. The emitted sulfur dioxide gas will be invisible, but the flash or particulate matter may be evident and collected on a sampling device.

Chemical Companies: By researching some of the chemicals produced by the individual company, one can have some idea of the possible pollutants. Sometimes, if acids are produced, a vinegary smell is present. Students might observe what effects the chemicals have on surrounding buildings and plant life. A variety of other odors may also be present.

Soap Companies: Since soap manufacturing involves the cooking of animals, strong odors are often present. These are sometimes uncontrolled and provide a good lesson in observation.

By researching the various industries to be observed in an area, students can become aware of the operations involved in production and also of the possible pollutants.

As a part of any visit to an industrial area, the visitor should pay particular attention to the odor of the air. The following activity allows us to do this in a fairly formal fashion.



ACTIVITY B: ODORS ASSOCIATED WITH POLLUTANTS

In dealing with polluted air, one of the most easily detected observations is odor. The United States Public Health Service has determined scales for observing and comparing various samples of air. Some of the data are collected with very sophisticated instrumentation and techniques. However, there are several observation techniques that need only a nose and a somewhat consistent judgment. As with many of the other tests, there is a great deal of subjectivity on the part of individual observers.

Many students may have noticed odors in their own communities or in other places that they have visited. Questions for discussion might include these:

1. Are all odors unpleasant?
2. Do odors cause any harm?
3. Can odors be used to detect air pollution?

The U.S. Public Health Service identifies four characteristics of odors that can be perceived. These are intensity, odor quality, pervasiveness, and acceptability. The test for pervasiveness is difficult to do, since it deals with comparison to known dilutions of air. The tests which students might be able to deal with are these:

1. *Intensity*

It is believed that the nose can detect about thirty different intensities of odor. However, this test asks the observer to differentiate odors on four different intensities.

The scale for intensity is

0 - No odor
1 - Just detectable
2 - Definite
3 - Strong
4 - Overpowering

2. *Quality*

In order to analyze the quality of the odor, one should compare it to a known type of odor. Three known odor types which could be used are fragrant, acid, and burnt. If there is no semblance to a specific type of odor, the quality code for that odor would be zero. A moderate odor would rate a 4; a high amount of odor would rate a maximum of 8. Each of the three odor types would be rated on this scale, from 0 to 8. The final quality code would consist of three separate digits, each describing a different type of odor.

3. *Acceptability*

Students could rate acceptability from pleasant to unpleasant. A suggested scale could be

1 - very pleasant
2 - pleasant
3 - indifferent
4 - unpleasant
5 - very unpleasant

Students could record results on a chart, specifying time, date, location, and probable cause.

ACTIVITY C: AIR POLLUTION INDEX

One of the methods by which to determine the effectiveness of the environmental management of air pollution is to use the air pollution index determined and published by local air pollution control boards. The daily index number is determined by using reference numbers for various monitored pollutants. When these are graphed, it might be helpful to include the various statements which describe different levels.

Index Value	Statement	
0 - 40	Excellent	Better than the Clean Air Standards
41 - 60	Very Good	
61 - 80	Good	
81 - 99	Fair	
100	Clean Air Standards	
101 - 125	Unsatisfactory	
126 - 150	Poor	
151 - 175	Very Poor	
176 - 199	Extremely Poor	
200 - 299	Alert Level	
300 - 399	Warning Level	
400	Emergency Level	

If data on the air pollution index is not available, the following data can be used. The figures listed in the following table describe actual results which occurred in Cleveland, Ohio. On Wednesday,

September 5, an alert was called, and on Thursday, September 6, the alert was terminated:

Date	Day	Index Number
1	Sat.	174
2	Sun.	137
3	Mon.	167
4	Tues.	201
5	Wed.	258
6	Thur.	147
7	Fri.	50
8	Sat.	105
9	Sun.	44
10	Mon.	70
11	Tues.	107
12	Wed.	77
13	Thur.	114
14	Fri.	106
15	Sat.	108
16	Sun.	35

Questions for discussion:

1. What restrictions should be used during an alert?
2. What would account for the low numbers on Saturdays and Sundays?
3. What can be done for people who are affected by the high levels of pollution during an alert?
4. How can the problem of a possible alert be eliminated?

ACTIVITY D: LOCAL INDUSTRIES

Many industries now devote large portions of their budget to environmental control. Some of them are willing to be contacted by students and interviewed. The amount of money that is spent on environmental control is usually reported, and this amount can be compared to the amount of total expenditures. Past experience in contacting industry has shown that the pollution control programs will usually be readily explained. However, it is sometimes difficult to collect information when the industries are being studied by legal authorities for possible violations. Most of the firms have public relations personnel to deal with citizens. Some of the larger companies have directors of environmental control, who are often willing to speak to students.

Tours of the industries, if available, can be very interesting, as can the specific information offered by each industry. Students might prepare charts which list all of the industries contacted, the persons interviewed, expenditures, and specific procedures and devices which are being used to control pollution.

An example of a chart for collecting information from industries follows:

Name	Contact Person	Products Produced	Pollutants	Total Budget	Envir. Budget	% Budget	Anti-Poll. Devices

ACTIVITY E: SIMULATION

A student or a group of students may represent one of the interest groups involved, prepare a statement of position, and try to convince others of that position.

During 1973, the Ohio EPA has had to deal with some major changes in the sulfur dioxide regulations. Some of the changes would serve as ideal problems for a simulation exercise:

1. Changing the compliance deadline for emission from July, 1975, to July, 1977.

   One argument for the change would be that many industries are in the process of changing their production so that they can comply with the regulations, but, because of difficulties in the development of anti-pollution devices, they have been unable to comply without shutting down completely. An additional two years would allow them to comply by 1977 and still remain open. Of course, someone in opposition might say that the air situation is so critical at the present time that the deadline should not be extended.

2. Changing emission limitations in different counties.

   Current regulations:

   a. 46 counties in Ohio must meet maximum restrictions now.

   b. 15 counties now have less stringent restrictions but must meet maximum restrictions by 1975.

   c. 25 counties now have no restrictions but must meet maximum restrictions by 1975.

   Proposed regulations:

   a. 8 counties must meet maximum restrictions now.

   b. 13 counties would have to meet less stringent regulations and never meet maximum regulations.

   c. 67 counties would have no restrictions, except to continue to burn low sulfur fuel.

3. Classifying regions
   Classification is now by regions, and some relatively clean counties are classified with dirty ones which are in the same region. With the proposed change, classification would be by individual county rather than region. Fifty-eight counties out of eighty-eight would have a change in priority status.

If there are any local pollution problems, such as a variance granted to an industry, a new industrial park, construction of a superhighway, changes in public transportation, landfills or incineration of garbage, or anti-pollution control devices on cars, they may be more suitable. If students select the problem, there is likely to be more interest. Each student is a member of a representative interest group in the simulation. These interest groups should in reality have some influence in the final decision.

Some of the suggested interest groups are:

1. Mayor or local officials.
2. City council or local governing body.
3. Ohio Environmental Protection Agency.
4. Group of interested and vocal citizens.
5. Group of businessmen or professionals.
6. Representatives from local industry.

Each group should research by collecting information on the problem and then prepare a position paper, which would be duplicated and distributed to the other groups. Another group would serve as a control unit to facilitate the simulation. All groups would meet separately and send written messages to the facilitating group for distribution to the other groups. This group would be in control of all communications. The messages would describe the simulated actions of each group. The control group may also send messages, which might describe acts of nature or legal authorities, in order to make the simulation more interesting. At a prescribed time, the simulation would be ended and a decision would be made by the control group as to the final outcome.

EXPERIENCE #4: SOLID WASTE MANAGEMENT

OBJECTIVES:

At the conclusion of this experience, the student will

1. better understand the management process used in the collection and disposal of trash.
2. better understand the problems encountered by a sanitation department.
3. better understand the problems of trash handling and littering.
4. be able to recognize the septic tank as an alternative means of waste disposal.
5. understand the function of a compost pile as a method of utilizing certain solid waste materials.
6. be aware of the structure and methods involved in alternative types of solid waste disposal.
7. be aware of biodegradable wastes and the methods used in ridding ourselves of these wastes.

Teacher's Note:
It is recognized that the first three experiences relate exclusively to air pollution, its problems and management. This experience provides activities relating to other forms of pollution, their problems and their management. The same approach as was used in the first three experiences is used here, and the activities are designed to be used as the need arises.

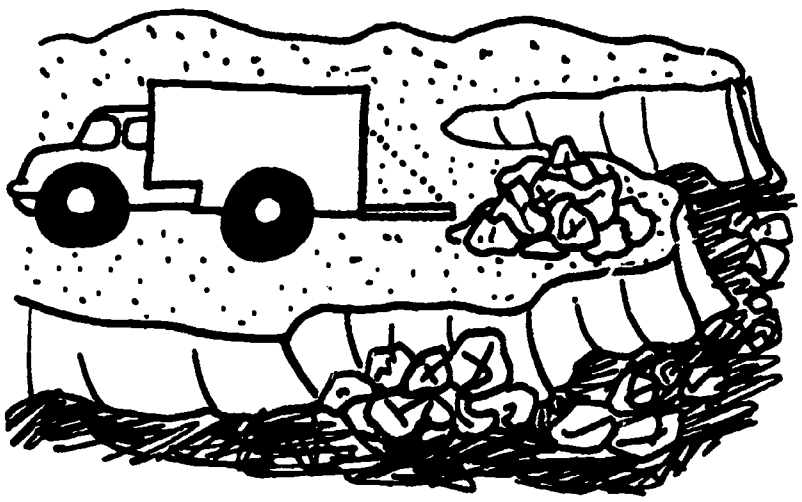
ACTIVITY A:

Students will research the methods of garbage pick-up and handling in their city or community. They will interview heads of the sanitation department for this information. They will define areas of pick-up on

a city map and label as to day of pick-up. They will find out the number of men employed, average pay and hours they work. Students will observe these men picking up waste as to methods and degree of efficiency. Look for sloppy techniques.

Questions for class discussion:

1. Where is garbage taken?
   a. How is it disposed of?
   b. Is incineration used?
   c. If so, how complete is the incineration?
2. Is garbage taken to a land-fill?
   a. If so, where is it located?
   b. What are the techniques used here?
   c. How is it handled?
   d. What precautions are used?
   e. What is the life of a land-fill?
3. If the garbage is not taken to a land-fill, how is it disposed of? What is the advantage/disadvantage of this method as compared to a land-fill? Apply questions 2 b, c, and d to this method.



ACTIVITY B:

Contact a company that maintains a land-fill. Ask about procedures followed at the site. Chart all cities using the fill. Get estimates of proportional amounts deposited by each client. Look for evidence of environmental influences such as run-off, changes of terrain, damage to streams and trees, and air pollution Determine if any local environmental groups have researched the land-fill. Analyze deposition samples for constituent make-up. Sample for presence of diseases and amount of transmittable bacteria. Observe other land-fills as to how they were developed for use after the filling was completed and the structure covered and closed.

ACTIVITY C:

Observe incinerators. Attain data on amount of waste handled per day, temperature of incineration, quality of waste gases, and condition of the residue. Determine what is done with the residue. Analyze for sterility levels of the residue. Research various types of incinerators for EPA standards. This can also be expanded to incinerators in schools, hospitals, and industries. (See Appendix A)

ACTIVITY D:

Have students prepare discussion on the quality of garbage disposal. Have students list their suggestions on how these methods could be improved in their community. Have a group approach officials for answers to their questions of improper disposal. Is change possible? (See Appendix A)

ACTIVITY E:

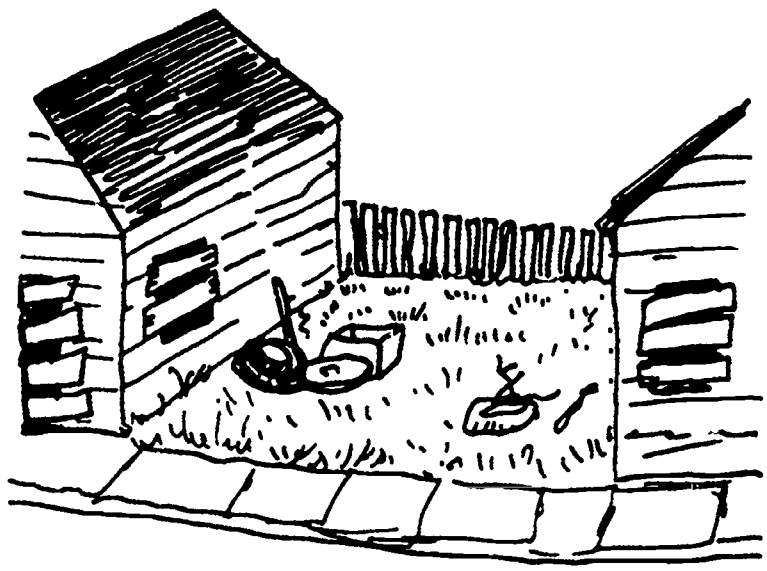
Have students search for vacant lots that attract trash. Give descriptions of these lots, particularly of the kinds of things found there. Look for areas where dumping occurs. Map all areas of dumps and littered lots.

Questions:

1. Who owns these vacant lots?
   a. What does the city do about land owners that do not correct these situations?
   b. How strict are the laws and how much are they enforced?
   c. How often is trash picked up?
2. How dangerous are objects found there to youngsters who play in these areas? What about the aesthetic values such lots have on the environment?
3. How is dumping controlled?
   a. What effect do abandoned cars have on this area of trash?
   b. How do junkyards control their situation?
   c. Is there any kind of forceful upkeep by the city for junkyards?

Gather data relevant to vacant lot litter.

1. Location of lot:
2. Physical condition of property:
3. Description of trash:
4. Owner of property:
5. Past history of the uses of the property:
6. Past history of legal prosecutions (if any):



ACTIVITY F:

Observe various types of litter on city streets. Describe the litter laws of the city. Find out the number of prosecutions for littering over a given time span. Students observe school building; halls, rooms, cafeteria and outside grounds.

Gather data relevant to street litter.

1. Street location:
2. Physical description of street as to buildings:
3. List of litter observed:
4. Estimation of the quantity of litter:
5. City maintenance schedule for street cleaning times:
6. Evaluation by observer as to degree of maintenance:
7. Evidences of rat habitats due to litter:
8. Length of observation:

Questions for discussion and/or research:

1. How much does littering contribute to the trash problem?
   a. Do residents keep up with li''er?
   b. What part do shopping centers, malls, and individual stores do to contribute to litter?
2. Are the number of trash containers adequate?
3. Are the litter laws enforced?
4. How often are streets cleaned by the city?
5. What part do students have in littering?
   a. Can students participating in class, influence other students to stop littering?

ACTIVITY G:

Interview the sanitation department and translate information about the amount of trash handled by the city daily. Obtain information concerning the various areas of the city as to the differing speeds of trash build-up.

Questions:

How does trash build-up reflect on living conditions and real estate values?

a. How much emphasis is placed on homeowners and businesses for upkeep of their areas of concern?
b. Are violations cited and fines enforced?
c. How do abandoned houses and buildings increase trash build-up?
d. How are these conditions handled by officials?
e. Who is held responsible?
f. How frequently do health officials inspect these areas and what is the frequency of citations?

ACTIVITY H;

Students should draw and label a septic tank system. Have students survey areas where they are used. Question owners of such systems about their effectiveness and question the owner's degree of satisfaction. Survey areas where new housing projects are being built. Find out what types of sewage treatments they have.

Questions:

1. What effect does improper septic plumbing have on the environment?
2. Are they designed to protect the environment?
3. Should city type sewage treatments replace septic tanks? If so, how can this be done economically?

ACTIVITY I:

Survey areas of compost piles. Describe them. Take samples of the materials found there for analysis. Observe area for animal habitats.

Questions:

1. Are balances thrown off by this method?
   a. Is the pile a source of food for animals in the area?
   b. Is there runoff from the pile?
2. Should rural towns create a better method of waste disposal?
   a. Can they establish collections and dispose of waste themselves through city-type methods?
   b. What would be the cost of such a system?
   c. Is it feasible for small towns?
   d. What about interacting waste systems between the major city and rural towns?
3. Aren't land-fills sophisticated compost piles?
   a. What are the differences?
   b. How are the wastes handled in each type of system?

ACTIVITY J:

Students should research the kinds of wastes produced by various types of industries in the local area. Survey their methods of waste disposal. Expand this type of research to schools and hospitals.

Questions:

1. Do these companies handle their own or do private concerns remove the by-products?
2. How do hospitals dispose of disease laden wastes?
3. Do these institutions have incinerators?
   a. How effective are they for disposing of waste?
   b. What type of residue is left by the incinerators?
   c. Is there complete burn?
   d. How sterile is the residue?
   e. How do the companies remove the residue and where is it taken?
   f. Is it safe?
4. Is increased industrial output a fair exchange for inadequate handling of wastes?
   a. How has the progress of our economy produced a burden on waste removal?
   b. Do city officials realize this problem?
   c. If so, do they intentionally neglect the situation so that our economy is not hindered by rules of proper waste disposal?

APPENDIX A:
DATA SHEETS

Incinerator Data Sheet

Location of Incinerator	Type of Unit	Effluent Data	EPA Standards

Garbage Pick-Up Data Sheet

Area Observed:
Day of Pick-up:
Number of Employees:
Degree of Efficiency of Job:
Where is Garbage Taken?:
What are Methods of Disposal?:
Length of Time Observations were Made:

APPENDIX B: ENVIRONMENTAL AGENCIES

Air Pollution Technical Information Center
Environmental Protection Agency
Research Triangle Park, North Carolina 27111

National Audubon Society
1130 Fifth Avenue
New York, New York 10028
Publication: *Audubon*

National Parks Association
1300 New Hampshire Avenue, N.W.
Washington, D.C. 20036
Publication: *National Parks*

National Wildlife Federation
1412 - 16th Street, N.W.
Washington, D. C. 20036
Publications: *National Wildlife*
Ranger Rick's Nature Magazine (for children)

Nature Conservancy
1522 K Street, N.W.
Washington, D.C. 20005
Publication: *Nature Conservancy News*

Sierra Club
1050 Mills Tower
San Francisco, California 94104
Publication: *Sierra Club Bulletin*

The Wilderness Society
729 - 15th Street, N.W.
Washington, D.C. 20005
Publication: *The Living Wilderness*

APPENDIX C: RESOURCE MATERIALS SOURCES

An experiment in Environmental Microbiology Kit (Millipore Corporation, Bedford, Mass. 01730) is useful in collecting samples of air. Activity booklets are available.

A booklet describing the Ohio EPA is available from the offices:

State of Ohio Environmental Protection Agency
P.O. Box 1048
Columbus, Ohio 43216

One may request the free monthly newsletter, "Newsleaf," or the "Weekly Review" at $15.00 per year.

REFERENCES

BOOKS:

Anderson, Edwin P. *Drainage House.* Indianapolis: Audel, 1960. Disposal Guide.

Andrews, William A. *A Guide to the Study of Environmental Pollution.* Englewood Cliffs: Prentice Hall, Inc., 1972. Resource book which deals primarily with air and water pollution. Features background information, questions for discussion, research topics, and case studies.

Breuer, Sandra Sanders, and William F. Goodykoontz. *Environment: Earth in Crisis.* New York: Scholastic Book Services, 1973. Class studies, skits, and essays are written in a contemporary style. Reading level is suitable for most students.

Environmental Protection Agency. *Air Pollution Engineering Manual.* Research Triangle Park: Environmental Protection Agency, 1973. A technical publication listing data and specifications on air contaminants, control equipment, and processes that cause emissions. Written in relation to Los Angeles County but is applicable in other areas.

Fallows, James M. *The Water Lords.* New York: Bantam, 1971.

Foster, Phillips W. and Roger H. Hermanson. *Programmed Learning Aid for Introduction to Environmental Science.* Homewood: Learning Systems Company, 1972. A very contemporary resource book. Contains much background information which relates to current environmental problems. Has a variety of special topics. Format is a program for self-instruction.

Goldstein, Jerome. *Garbage As You Like It.* Emmaus, Pa.: Rodale Press, 1970. This book is an excellent resource. It can easily be understood by students. It can also aid the teacher.

Lorbeer, George. *Circle of the World.* New York: Benziger, Inc., 1972. Readings in the environment. Essays and case studies which are valuable for discussion. Reading level is difficult for some students but a glossary is included with each article.

Love, Sam and David Obst. *Ecotage.* New York: Pocket Books, 1972.

Lynch, Patricia and Robert Chandler. *National Environment Test.* New York: Pocket Books, 1971.

Nader, Ralph and Donald Ross. *Action for a Change.* New York: Grossman Publishers, 1972.

National Tuberculosis and Respiratory Disease Association. *Air Pollution Primer.* New York: National Tuberculosis and Respiratory Disease Association, 1969. Features basic information on air pollution in an easy to read manner.

Nichols, Herbert L. *Drainage.* New York: Van Nostrand, 1957. Machinery around your country home.

Nobile, Philip and John Deedy. *The Complete Ecology Fact Book.* Garden City: Doubleday & Company, Inc., 1972. Books of facts on the environment. Convenient for quickly obtaining facts and figures. Deals with many aspects of environmental management.

Novick, Sheldon (ed.). *Our World in Peril.* Greenwich: Fawcett, 1971.

Pringle, Lawrence. *The Only Earth We Have.* New York: MacMillan Company, 1971.

Rasmussen, Frederick A., Paul Holobinko and Victor M. Showalter. *Man and the Environment.* Boston: Houghton Mifflin Company, 1971. Student textbook written through the Educational Research Council of America. Contains many experiments which can be performed by students. Can be used for students to develop ideas for further experimentation.

Schatz, Albert and Vivian Schatz. *Teaching Science With Garbage.* Emmaus, Pa.: Rodale Press, 1971.

Simon, Seymour. *Science Projects in Pollution.* New York: Holiday House, 1972. Book of ideas for students to use on starting projects on environment.

Small, William E. *Refuse and Refuse Disposal.* New York: Praeger Publishers, 1971. Third Pollution; the national problem of solid waste disposal.

Snyder, Ernest. *Please Stop Killing Me.* New York: Signet Books, 1972.

Taylor, Gordon R. *The Doomsday Book.* Greenwich: Fawcett, 1970.

Tucker, Anthony. *Toxic Metals.* New York: Ballantine Books, 1972.

Wagner, Richard H. *Environment and Man.* New York: W.W. Norton & Co., Inc., 1971. College level textbook on almost all areas of environment. Written in a fashion which is not overly technical. Provides a good source for background information.

PERIODICALS:

Environmental Magazine, P.O. Box 755, Bridgeton, Missouri 63044. ($10.00 a year).

TEACHER'S NOTES:

COMMUNITY PROBLEMS

The student is a citizen affecting the community in which he lives. Knowing that no one has problem-free surroundings, we believe that every student should be able to recognize what some of these problems are. In order to develop good citizenship in the student, the teacher should present an opportunity for the student to study a method for recognition, evaluation, and correction of local bio-physical problems.

This unit suggests the steps for the investigation of an environmental problem found in a local community, suburban or rural, and the strategies and actions for change. The activities can be carried on in a self-contained or open classroom setting using a structured or unstructured approach. "The outcome is oriented toward students making decisions based upon their knowledge of community function and structure, and upon their own particular values, as well as the values of society." (CDEC 8/8/73.)

It is necessary to point out that this unit is problem focused rather than discipline focused; the student chooses the problem, then learns science by investigating it, math by analyzing his information, social science by finding out how to get desirable change in the community with respect to the problem, and English by communicating the information he has found in writing and speech in a way to get that change. Emphasis is on the student and his ideas; consequently, this outline allows for flexibility on the part of the teacher and the student. It is hoped that the procedure presented here will be followed but that the particular methods and techniques will be taken as examples. At the end of the unit plan, there is a list of possible problems which can be studied in school. The teacher should pick the best problem or problems to work with and follow the general outline presented here. It is advisable for the teacher to process more than one problem if the time permits. Also, the teacher should think about liability and obtaining parents' permission for the trips during the survey. He should also try to motivate students to investigate various problems and to teach the students how to work in groups. Avoid having individual students do the work of the whole group.

INSTRUCTIONAL OBJECTIVES:

At the conclusion of this unit, the student will be able to:

1. Appreciate how he and other citizens effect the environment.
2. Survey and inventory environmental problems.
3. Gather and employ related information derived from research and experimentation.
4. Suggest means for alleviating some environmental problems.
5. Carry-out effective treatment of some environmental problems.
6. Summarize and report his results in an understandable, logical and useful manner.

CONTRIBUTORS TO THE DEVELOPMENT OF THIS UNIT

Authors .....Sister Mary Isidore, SND.
Mary E. Mather
Editor ..... Stoyan N. Topalof
Revisor .....Gary Rudolph

TABLE OF CONTENTS

EXPERIENCE #1:
IDENTIFYING LOCAL PROBLEMS

OBJECTIVES:

1. After involvement in this experience, the students should be able to identity and list general community problems.
2. The students should be able to select specific community problems for further investigation.

ACTIVITY A:
DETERMINING AND DISCUSSING THE NATURE OF COMMUNITY PROBLEMS

1. The students identify or define the meaning of environment.
2. Community problems can be dealt with in several ways, depending on location, time available, type of student, etc.

Teacher's Note:
Investigations can be limited to a definite distance around the school or to the school grounds alone.

a. *In the Classroom*: Working in small groups, have students list community problems found within a determined distance of the school.

Note: A few leading questions and/or comments may be needed to elicit the desired results. Below is a sample list that might be developed:

dumping
abandoned cars
stray dogs
noise pollution (screaming cars)
rats
sewers
erosion
junk around
people who don't care
stealing
drugs
soil pollution
transportation
traffic hazards
dead animals
air pollution
people not keeping up yards
water pollution
abandoned buildings
roaches
too many fires and fire hazards
weeds
over-population
accidents
crimes
vandalism
bus system

b. *Take a Walk*: Have each student submit a written record of environmental problems they encounter while walking about the immediate vicinity of the school.

c. *For Homework*: While going to and from school, observe and record the environmental problems encountered.

Materials:
Paper and Pencils
Blackboard and/or overhead

3. Compile a listing of the problems recognized by the class.

Organize and evaluate the problems using a value scheme:

Nature of problem	Evaluation*	Reason**
1.		
2.		
etc.		

*Evaluation may be done according to a scheme such as this:

1. Important and can be changed
2. Important, but will not be able to resolve.
3. Not important.
4. No interest.

**Explain why each number value was given.

Teacher's Note:
This part of the activity might be completed either as a class discussion, as a written assignment (with information being shared in small groups of 5 to 6 members), or as the results of a questionnaire distributed throughout the school and/or neighborhood.

Materials:
Paper and pencil

ACTIVITY B:
SELECTING SPECIFIC PROBLEMS FOR FURTHER INVESTIGATION

Teacher's Note:
The following may be used as an introductory activity, as a supplement to your regular curriculum, as a replacement of your regular curriculum, as an extra-curricular assignment, or in any other fashion you may find useful. Therefore, the manner in which the "problems for further investigation" are assigned may vary considerably. The following are just a few suggestions:

1. Individually, a student selects a single problem for investigation. At the close of his research, he will report his findings to the class.
2. Working in small groups (2 to 3 members), students investigate a single problem. At the close of their research, the group will report their findings to the class.
3. Working in small groups (2 to 3 members), students will investigate a set of major problems (eg. air, water, waste disposal, population, etc.) A summary report on all of their investigations is required.

EXPERIENCE #2:
SURVEYING AND INVENTORYING THE PROBLEM

OBJECTIVES:

1. The students should design a survey (inventory) sheet.
2. The students should collect data in a field observation situation.

ACTIVITY A: DESIGNING A SURVEY

Teacher's Note:
An introduction to complete census and random sampling surveys would be in place here. Regardless of the exact nature of the investigation being made, the student or group of students must have a general concept of how to conduct a survey.

1. Introduce the topic by a class discussion.
   a. What data or questions should be asked about the community problems identified? What is data?
   b. What is a survey? How do you determine who/what is to be included in your survey?
   c. How can tha data gathered in the survey be organized?
2. Drawing Up the Survey:
   a. Point out that "feelings," "personal values," and "public opionion have already been sampled (in Experience #1, Activity A, parts 2 and 3).
   b. Ask each group to prepare their surveys in a manner that is not dependent on opinions or talking to people. Elicit a survey of observations of specific times, areas, frequencies, etc.
3. Making a Map

Teacher's Notes:
Methods such as pacing and triangulation are explained in most field ecology or field geology texts.

   a. In survey work, a map provides an excellent reference — sites of problems can be pinpointed, a basis for the survey procedure can be established, and result patterns can be represented.
   b. You may experiment and have the students construct their own base maps.
   c. In certain situations it is advisable to have standardized maps of the study area available for the entire class.

Materials:
Paper and pencil
Rulers & straightedge
Compass

ACTIVITY B: GATHERING DATA

1. Depending on how the investigation is designed (see Experience #1, Activity A, part 1) conduct the survey.
2. Tally and total results. It is suggested that the use of tables and graphs be emphasized. Also, if a base map has been drawn, plot meaningful statistics on the base map.

Materials:
Survey sheets
Paper and pencil
Base maps

EXPERIENCE #3:
GATHERING ADDITIONAL INFORMATION

OBJECTIVES:

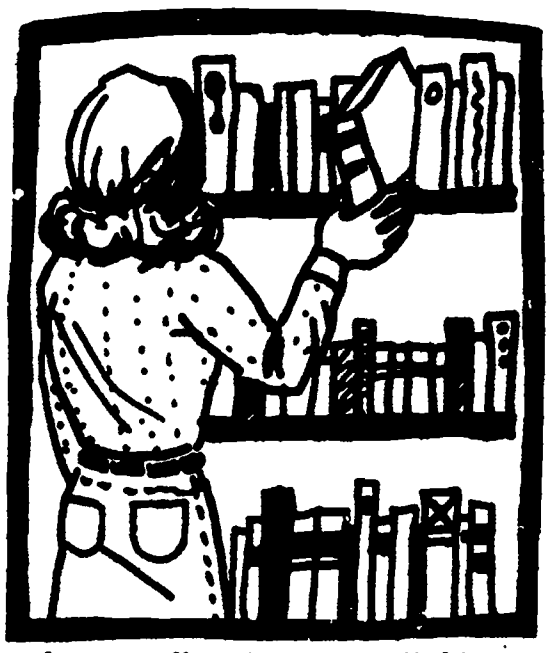
1. The students will find sources from which to get information pertaining to the question.
2. The students will design and construct needed equipment and/or learn how to use equipment in order to suggest a plan of action in solving the problem.

ACTIVITY A:
RESEARCHING THE PROBLEM

Teacher's Note:
The students should have available the listing of A-V materials present in the school and the library facilities of the school and the nearest public library, if possible. If the students are limited to the classroom for their activities, multi-texts could be made available, as well as a teacher loan.

Various catalogs and the Yellow Pages of the telephone directory should be made available to the students. The factors of time and availability of money should be pointed out to the students for their consideration.

Depending on the class ability to take notes, it may be necessary to either discuss note taking or to substitute outlines or summary paragraphs for the running notes.



1. The students will refer to available resources. (Keep in mind that some outside sources may require a 3 to 4 week period to respond.) Determine a lower limit on the number and variety of references to be demanded, for example:
   a. Audio-visual materials
   b. Books
   c. Magazines
   d. Organizations
   e. Businesses
   f. Governmental Agencies
2. The students will use sources of information and take running notes pertaining to the problem. (These notes will be used later when the group's findings are to be reported.)

Materials:
Paper and pencil
Listing of resource materials

ACTIVITY B:
EXPERIMENTATION AS A TOOL FOR GATHERING INFORMATION

Teacher's Note:
Whether the experiment is designed and conducted as independent research or as a group activity, it is essential that you provide resource materials suggesting procedures and be available yourself as a resource person. In some cases, talented or experienced students can also serve as a resource.

1. The students will design and construct needed equipment as well as learn how to use it in order to suggest a plan of action in solving the problem.
   a. Prescribe a definite limit on the time allowed for gathering the materials and setting up the experiment.
   b. Allow sufficient time for the experiment to run to completion.
2. The students will conduct an experiment using prescribed equipment and techniques.

Teacher's Note:
The companies that manufacture products such as Millipore Filtering Systems, La Motte Water Testing Kits, etc., usually provide teacher's manuals that offer excellent suggestions for student activities.

EXPERIENCE #4: ASSESSING AND REPORTING RESULTS

OBJECTIVES:

1. The students will design and administer a survey to determine community sensitivity about the problem.
2. The student will be able to assess his/her results.
3. The students will synthesize their information into a report.
4. The students will organize and present their findings in an informative way.

ACTIVITY A:
CONDUCTING ANOTHER SURVEY

Teacher's Note:
Keep this second survey specifically related to the problem under investigation.

1. The students will design and administer a survey to determine community sensitivity about a problem and/or determine if an effective solution has been found.
2. Tally and record the findings of your survey. Examine the date, keeping the following questions in mind:
   a. Has the problem been satisfactorily investigated?
   b. What additional problems have resulted from our solutions?
   c. Has an effective solution to the problem been determined? Can improvement be realized?

ACTIVITY B:
REPORTING THE RESULTS

Teacher's Note:
It is worth challenging the students to select one method of reporting their results in each of these categories: written or project form, personal report, and the use of an outside resource (speaker, movie, etc.).

1. Ask the students to report their results using several methods. Below is a sample list of methods for reporting findings.

   Audio-visuals (show, movie, etc.)
   Collage
   Collection of related newsclippings
   Debate
   Future dreams ("If I were in charge, I'd . . .")
   Interview (written or taped)
   Letters (answering questions)
   Models (replicas)
   Oral Presentation
   Personal speech by authority to class (live or taped)
   Photographs/slides
   Role playing
   Symposium
   Written report

APPENDIX A:
SAMPLE PROBLEM: TRANSPORTATION

EXPERIENCE I: IDENTIFYING

ACTIVITY A: CLASS DISCUSSION

Teacher's Note:
The teacher should ask a few leading questions that will help the class to select a problem for investigation.

Topics for discussion:
1. People and their transportation needs
2. Means of transportation
3. Established patterns of transportation
4. A desirable transportation system
5. Problems resulting from inadequate patterns of transportation.

ACTIVITY B: INVESTIGATING

1. Students bring in news articles or new transportation means.
2. Study transportation of the future, moving sidewalks, elevated walkways.
3. Visit airport, train station and look for problems.
4. Study bus routes, trucking schedules.
5. Walk around the neighborhood recording problems related to transportation.
6. Obtain a map of the United States and determine the best cross country route.
7. Obtain a city map and find the best routes to school.

EXPERIENCE #2:
SURVEYING AND INVENTORYING THE PROBLEM

ACTIVITY A: DEVELOPING A QUESTIONNAIRE

A questionnaire can be devised by the student to aid in gathering information about transportation patterns to and from school. The student should determine who should be included in the survey.

1. Sample Questionnaire
   a. What means of transportation do you use in coming to and going home from school?
   b. What time do you come to school? Leave school?
   c. What roads, paths, streets, alleys, bike paths, or sidewalks do you use in getting to school?
   d. What problems do you encounter in your travels?
      Heavy traffic? What time? Where?
      Dangerous intersections? Where?
      Unsafe roads? Where?
      Pedestrians crossing the street? Where? When?
      Unsafe places to bicycle? Where? When?
      Unsafe places to walk? Where? When?
      Parking problems? Where? When?
      Other problems? Describe them.
2. Ask a group of students to prepare a survey sheet that does not require talking to people - just observation at specific times, areas, etc.

ACTIVITY B: ADDITIONAL ACTIVITIES

1. Students could observe traffic at various times and locations and record observations.
2. Students could consult with zoning department or traffic engineer for traffic survey results.

EXPERIENCE #3
GATHERING ADDITIONAL INFORMATION

ACTIVITY A: GATHERING MORE INFORMATION

1. Questions for discussion
   a. What is the local governmental unit?
   b. Is there a traffic engineer or traffic department?
   c. What role does the highway department play in solving our problems?
   d. Where does the money come from for our highway improvement?
   e. What is the role of the policeman in maintaining safety?
   f. Are our patterns of transportation part of a larger community transportation plan assembled by a planning commission?
2. Sources of information: Call or write
   a. Police, law enforcement agencies
   b. Highway department
   c. Planning commission
   d. Traffic commission

ACTIVITY B: INVESTIGATING

1. Have speakers from agencies mentioned above.
2. Visit highway patrol, planning commission, traffic engineer's office.
3. Have students do research on experimental cities and their transportation answers.
4. Study mass transit systems as a means of conserving space and energy.

EXPERIENCE #4:
ASSESSING THE RESULTS

Teacher's Note:
The class may attempt to decide this by using statistics or graphs.

ACTIVITY A: QUESTIONS FOR DISCUSSION

1. What were we trying to accomplish?
2. Why were the improvements necessary?
3. How do we know if there has been any improvement?

ACTIVITY B: CONDUCTING ANOTHER SURVEY

Students should repeat observations or inventory of the problem to determine if an effective solution has been found.

1. Another questionnaire could be devised.
2. It should be related specifically to the problem the student isolated and hopefully helped to correct.
   a. Have you noticed any decrease in car traffic on Lincoln Street?
   b. Has walking to school on this route, in your opinion, become safer? How?
   c. Has the change affected the time it takes you to get to or from school?
   d. Have any other problems resulted from this change?

ACTIVITY C:
FINAL DISCUSSION QUESTIONS

1. What problems have we solved?
2. What additional problems have resulted from our solution?
3. What other problems remain to be solved?

APPENDIX B:
ADDITIONAL PROBLEMS FOR INVESTIGATION

Air
1. Local sources of pollution
2. Attempts of industry to curtail pollution
3. Effects of pollution on plants
4. A pollution monitoring station

Water
1. Water quality of local resources
2. Water treatment plants
3. Sedimentation of lakes, streams, ponds, rivers
4. Flood control and drainage patterns

Land
1. Multiple use of land resources
2. Zoning and land planning
3. Minerals and natural resources of land
4. Land management

People
1. Overpopulation, density
2. Environmentally-induced diseases
3. Housing, shelter
4. Recreation

Energy
1. Fossil fuels
2. Nuclear power plants
3. Solar energy
4. Local energy needs and resources

REFERENCES

BOOKS:

Bates, Marston. *The Forest and the Sea.* New York: Random House, 1960.

Branch, Melville C. *City Planning & Aerial Information.* Cambridge: Harvard Press, 1971.

Breuer, S. S. & W. F. Goodykoontz (editors). *Environment: Earth in Crisis.* New York: Scholastic Magazines, 1973.

Gordon, Alice K. *Games for Growth.* Chicago: Science Research Associates, Inc. 1972.

Holden, John & P. Herrera. *Energy.* New York: Sierra Club, 1971.

Hughes, Helen M. (editor). *Cities & City Life.* Washington, D.C.: American Sociological Association, 1970.

Jones, W. Ron. *Finding Community.* Palo Alto: James E. Freel & Associates, 1971.

Kaltounis, Theodore. *Teaching Elementary Social Studies.* West Nyack: Parker Publishing Co., 1969.

Keeble, Lewis. *Principles and Practice of Town and Country Planning.* London: Estates Gazette Limited, 1969.

Kjellstrom, Bjorn. *Be Expert with Map and Compass.* Harrisburg: Stackpole Books, 1967.

Leinwand, Gerald. *Air & Water Pollution.* New York: Washington Square Press, 1969.

Moran, Morgan & Wiersma. *Environmental Sciences.* Boston: Little, Brown & Co., 1973.

Nobile, Philip; Deedy, John (editors). *The Complete Ecology Fact Book.* Garden City: Doubleday, 1972.

Schatz, Albert; Schatz, Vivian. *Teaching Science with Garbage.* Eammaus: Rodale Press, Inc., 1971.

Sears, Paul B. *Where There is Life.* New York: Dell Publishing Co., 1970.

Simon, Seymour. *Science Projects in Ecology.* New York: Holiday House, 1972.

Simon, Seymour. *Science Projects in Pollution.* New York: Holiday House, 1972.

Smith, L. S. *The Ecology of Man.* New York: Harper & Row, 1972.

U.S.D.A. *A Place to Live.* Highway Development. Washington, 1963.

U.S.D.A. *Environmental Planning and Geology.* Washington, 1969.

Warren, Roland L. *Studying Your Community.* New York: Free Press, 1955. Assessing transportation needs, making a survey, questionnaires.

Wurman, S. W. (editor). *Yellow Pages of Learning Resources.* Cambridge: Group for Environmental Education, Inc, MIT Press, 1972.

LOCAL RESOURCES:

Environmental Bibliography Series prepared by the State Library of Ohio in cooperation with the Ohio Department of Natural Resources:

- Cleaning Up Our Environment
- Air Pollution
- Noise Pollution
- Water Pollution
- Pesticides
- Solid Waste

National Science Teachers Association

- Elementary Science Packet - Spring 1973
- Elementary Science Packet - Fall 1973

TEACHER'S NOTES:

FUTURISM

Today's Earthlings, as if caught up in a science-fiction space adventure, are unable to keep up with the changes in the world. The constant advance in science and technology has whirled humanity into so accelerated a spin that people find themselves plunging from one change to another without time or chance to consider or evaluate what is good or evil, right or wrong, helpful or harmful to themselves or to humanity as a whole.

The only surety we have about the future is that it is bound to be different. Educators of today must attempt to prepare our youth for tomorrow without knowing what knowledge will be considered truth when today's students become adults.

Only by learning to think and act creatively, to evaluate and predict, to make decisions and direct change can boys and girls of today hope to survive.

This unit on Futurism is designed to make students aware of some scientific, technological, and social advances of the past and present and to help them consider the implications of these changes for the future. Within it, the students are offered many opportunities to make decisions about their own education, to think creatively about problems which exist now and will extend into the future. Only by learning how to confront change and to form creative ideas will today's youth be ready to meet the challenge of the future.

This unit attempts to present opportunities for the teacher to choose among a variety of activities for classwork and for the students to make decisions about how they will learn subject matter. The activities which are carried out in the unit are interrelated, as they should be, and the overall plan is completely flexible. In order to meet the needs of a constantly changing world and an uncertain future, students and teachers alike should learn to adapt to change without losing sight of overriding values which are important in all areas of life.

Futurism is an activity-oriented unit, compiled to involve students in a creative-thinking, problem-solving program. Within the unit, each student gains some general knowledge about all the topics to be considered, carries out a personal investigation in an area of his special interest, develops important skills, learns the metric system of measurement, and cooperates with his classmates by applying his new knowledge in culminating class activity.

Because every community in the state has a stake in the future, many of the activities are community oriented. Students who are growing up now can not better serve themselves or their towns and neighborhoods then by becoming involved and learning what the future holds for them.

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CONTRIBUTORS TO THE DEVELOPMENT OF THIS UNIT

Authors ..... Ruth Spence
Sr. Esther Holtwick
Editor ..... Stoyan N. Topalof
Revisor ..... Sr. M. Kendra

INSTRUCTIONAL OBJECTIVES:

1. As a result of having completed the activities related to the metric system study in this unit, students will be able to understand and use the metric system units in stating specifications while building the model city of the future.
2. As a result of having completed the class activities and individual small group investigation activities on topics to be considered in this unit, students will:
   a. Acquire detailed knowledge about the future of one of the topic areas considered.
   b. Question the directions that science and technology are taking toward the future.
   c. Make some value-judgment decisions about what may be good or bad in the future.
   d. Predict the future in some or all of the areas considered.

d. Gain some new knowledge about each of the topics to be considered and become better prepared to face a changing future.

3. As a result of completing the activities in this unit, students will improve their skills in the following areas:
   a. Observation
   b. Note-taking for scientific information.
   c. Laboratory work.
   d. Reading for the main point in scientific articles.
   e. Recognizing scientific fact.
   f. Writing abstracts of science articles.
   g. Writing effective ietters to request information.
   h. Interviewing adults in order to learn information.
   i. Problem solving and creative thinking.
   j. Decision making.

EXPERIENCE #1
INTRODUCTORY ACTIVITIES

OBJECTIVE:

At the end of this experience, the student will realize the future to be an extension of the past and present.

ACTIVITY A:
PREDICTIONS OF THE FUTURE

Teacher's Note:
A possible list of topics which could be supplied to the students is presented below.

metric system
energy crisis
transportation
overpopulation
food
space exploration
computerization
industrialization
future housing
social structure in the future
education
man and medicine in the future

Each student chooses a partner. Hand out to each pair of students a dittoed list of topics to be considered for emphasis during the unit. Space for writing should be left after each topic. With partners, students write their own predictions about how life will be in each area in the year 2000 A.D. Students share ideas.

ACTIVITY B:
TIME LINES OF CHANGE
(A class activity for all students)

Teacher's Note:
This may be done on a completely in-class basis with students using reference books in class, or assignments may be made ahead of time so students can look up information outside of class.

1. The teacher allows the students to choose one of the following three groups, according to their interests: 1) plants 2) animals 3) man's inventions. The teacher assigns a time span to individual students, beginning with pre-historic times. Students look up their time span and find out what important scientific changes took plance at that time in history with respect to their own topics. A section should be included for future evolutionary changes and inventions, and this section should be assigned to especially imaginative students. Science fiction could be used as a reference.
2. Spread out a roll of shelf paper in the hall, mark off sections for the time spans, and let students write and draw pictures in their own sections.
3. Students view and compare the time lines. From the material contained in them, students discuss the following:
   a. Effect of inventions on plant and animal life in the past
   b. Effect of inventions on the life of man in the past
   c. Present effects of inventions on nature and cn man and his life style
   d. Possible future effects of man's technology on nature and on his own life style

ACTIVITY C:
SUMMARIES OF NEWSPAPER AND MAGAZINE ARTICLES
(Individual activity)

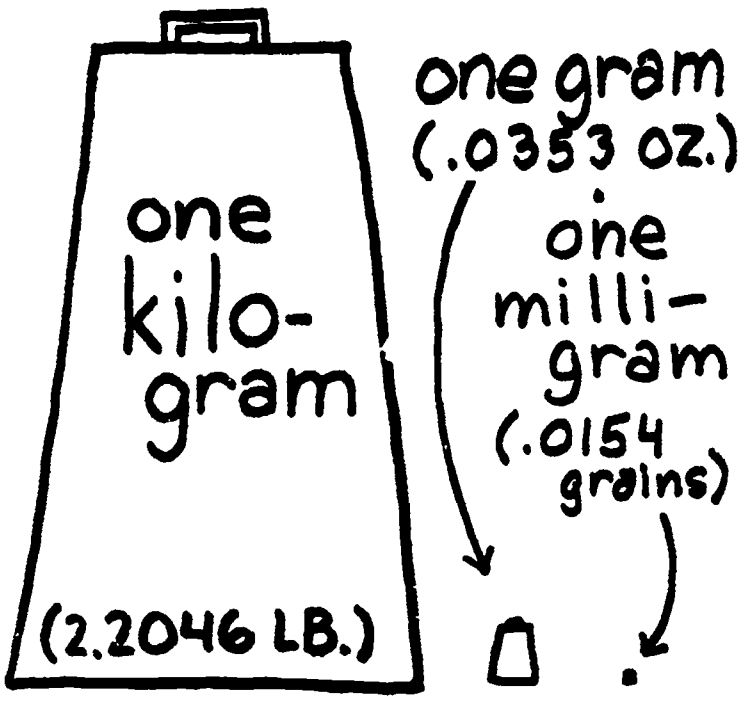
Students are to choose one or more of the topics about which they had made predictions in Activity A, and research these topics. Using the newspaper or magazines, students are to find one or two articles about the possibility of change and predictions for the future on their topics. They should read, tak- notes, and write summaries with correct bibliographic information on the articles.

The teacher should be careful to show students the correct methods for making summaries of articles. Students may report orally, or the teacher may type up the summaries on ditto sheets and distribute them to the class.

ACTIVITY D:
FUTURE POSSIBILITIES

Teacher's Note:
Check the bibliography for information regarding the audio-visuals mentioned here.

1. Students view either "Future Shock" or "2000 A.D."
2. Students discuss the connections between their own predictions, the articles read, and the material viewed.



EXPERIENCE #2
THE METRIC SYSTEM
PRESENT AND FUTURE

OBJECTIVES:

1. The student will realize the practical usefulness of the metric system.
2. The student will be able to compute and measure in metric units.
3. The student will be able to convert traditional units to metric units.

Teacher's Note: Procedure for Directions of Individual/Small Group Investigations

1. *Hand out a sheet for students to sign up to investigate topics included in activities B-H below. Limit the number of students to a topic so that all areas will be investigated by someone. A fair way to do this is to have students draw numbers and choose their topics in numerical order.*
2. *Give each student a list of the activities suggested for his topic.*
3. *Teach the following in class: correct form for writing an effective letter to request information or materials; ways to go about requesting and setting up an interview; questions to prepare for an interview before hand; how to carry on an interview. (The aid of an English teacher might be helpful for this part.)*

   Insist that students show you the questions they have prepared before they go to their interviews. A "trial-run" interview between the school principal and a student conducted in front of the class might be an effective means of showing all students how it is done.
4. *Probably some students will need special help or instructions in contacting people they wish to interview.*
5. *If possible, enlist interested parents to take boys and girls who are investigating the same topics on the trips connected with the investigation.*
6. *Each student should have a special notebook in which they write their observations, new knowledge, and ideas about each activity. Stress the fact that the more complete notes they make, the better equipped they will be to take part in the final class activity.*
7. *Hand out activity sheets for students to fill in during and at the end of their investigation.*
8. *Students carry on their investigations of topics on their own time or, with permission for release, during the school day. The laboratory work is done in school under the supervision of the teacher.*

Sample Activity Sheets

(The two examples following may be used by the teacher to guide the student on how to record the material he has researched or the investigations he has made.)

Sample Activity Sheet I

EXPERIENCE (title and explanation) _____

_____

_____

Results (data) _____

_____

_____

Conclusions: (How do you feel about what you did? What connections did you find between this and the rest of the material you have been studying?)

Sample Activity Sheet II

To be filled in by each student doing an investigation of a topic.

NAME _____ TOPIC_____

Briefly list the activities you completed as a means of learning more about your chosen topic.

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

5. _____

_____

List the authors, titles and sources of articles for which you wrote abstracts.

1. _____

2. _____ _____

What did you discover is the present state of affairs in this area?

_____

_____

What effects may this state of affairs have on future life?

_____

_____

What predictions can you make about the future in this area?

_____

_____

ACTIVITY A: INTEREST BUILDERS

Students discuss the following material:

1. Where did the metric system come from?

The metric system was introduced by the French in 1790, following their revolution. It was part of their plan to start their whole social and economic life afresh, without ties to the past).

At the time when the French invented the metric system, the systems in surrounding European countries were in great confusion. Every town or local government had its own variation of the system in use, and there were no standards. The French system was simple, and there was such a great need for one throughout Europe that it spread rapidly.

At the beginning of the nineteenth century, John Quincy Adams tried to persuade Congress to make the metric system the official system of weights and measures for the United States. In 1866, Congress made the use of the metric system lawful where it was more convenient, as in science and the military.

2. The metric system today and in the future.

Certain State of Ohio highway projects are being undertaken with metric plans to give their engineers practice in metric use and to discover problems of conversion.

Drivers on I-71 and I-90 in Ohio find mile/kilometer signs marking their progress.

Cincinnati baseball fans are exposed to metric conversion when attending the Reds' games. The distances to various points of the outfield fences are marked in both feet and meters.

Radio and TV weather reports now give you a choice. If the Fahrenheit temperatures reported in the 90's seem to warm, perhaps the Celsius temperature (centigrade) in the 30's seems cooler.

3. Teacher presentation of the basic metric units and what each measures, along with basic prefixes which change the value of the unit.

   meter = length
   liter = volume
   gram = weight
   Milli = 1/1000x
   Centi = 1/100x
   Deci = 1/10x
   Deca = 10x
   Hecto = 100x
   Kilo = 1000x

   Example: milligram = 1/1000 x a gram
   centimeter = 1/100 x a meter

Through the use of the table of conversions in Appendix B, students answer the following questions:

a. Do metric cowboys wear 38 liter hats? Prove your answer.

b. The broad jump record by Bob Beamon of America is 28 feet, 9½ inches. How many centimeters did he jump?

c. Babe Ruth holds the record for the longest measured home run at 640 feet. How many meters is that?

d. The total weighlifting record for one man is held by Vlasov of the USSR. He once lifted a total 551 kilograms for three lifts. How many pounds is that?

e. Which world record is faster, the mile run or the 1500 meter run? Provide mathematical evidence for your answer.

4. Students measure the surface of their desks or their own heights in metric units and in traditional units. Once they have figured out these measurements, students are to change them to another unit in the system they are employing. (Example: If they measure their height in feet, they should then convert this into inches. If they measure their height in meters, they should change it to millimeters or centimeters.)

5. Students discuss, as a class, the comparative ease of changing from one unit to another in both of the systems in question. The basic question is which system provides more ease in making this change?

Materials:

1. Metric sticks
2. Thermometers
3. Metric unit containers

The following sources might be helpful in teacher preparation for the metric system.

"Government Study on the Metric System" published by the Superintendent of Schools

Plain Dealer, "Sunday Supplement," Sept. 1973 (whole issue on metric system)

ACTIVITY B: LETTERS

Write letters to the public relations department of any or all of the following companies to request information on why industry is supporting a shift to the metric system for the United States: Warner Swasey Company; T.R.W. Co.; General Motors Corp.; White Motor Company; Republic Steel Company. (See appendix for locations.)

ACTIVITY C: RECIPES

Students could bring in their favorite cookie recipes written in conventional measurement units and rewrite them in the metric unit measurements. They could then attempt to make cookies at home, following metric measurements, if metric measurement instruments are available.

ACTIVITY D: BICYCLE GROUPS

One student in a group of 6-8 should have a bicycle. Groups of students walk to a given point from the school and back, counting the number of bicycle revolutions as they go. The distance they cover should equal one kilometer.

ACTIVITY E: METRIC MEASURE

Students measure and weigh water and sand or other chemicals in metric units. With a metric stick they measure different parts of the school. In good weather they might measure outside. Students might also measure their own height if not previously done.

ACTIVITY F: TEMPERATURE

1. Assign individuals or groups to check the temperatures daily and report degrees in both Fahrenheit and Celsius. All students should have a chance to do this at least once during the unit.
2. Students should keep a chart of their data and graph their result over a period of time. (A comparison of the graphs on both the Farenheit and Centigrade scales should prove that the change is proportional.)

ACTIVITY G: POPULATION DENSITY

Students may do either of the following:

1. Write to the city government for information on population density and square miles. Figure the population density in square kilometers.
2. Survey their neighborhood regarding the number of people per given area. Convert the area used into square meters, and determine the population density per square meter.

ACTIVITY H: DETERMINE NEEDS

Write to the government of a near-by city to find out population and amount of water used annually. Figure out the average amount of water used annually by each person. Convert these amounts to liters.

EXPERIENCE #3
THE ENERGY CRISIS AND ITS IMPLICATIONS FOR THE FUTURE

OBJECTIVES:

1. The student will be familiar with the factors contributing to the energy crisis.
2. The student will be able to identify some other sources of energy available to our society.
3. The student will be able to determine the implications of the present energy crisis for the future.

ACTIVITY A: ENERGY: DEFINITION AND TYPES

Teacher's Note:
The following information about the state of the fossil fuels should be made known to the class:

1. *There is a limited supply of fossil fuels.*
2. *They took 600 million years to form.*
3. *They are being replaced at a rate of 1/600 of percent supply every million years.*
4. *The annual U.S. demand for energy will double in the next 30 years alone.*
5. *The annual world demand will triple in the next 30 years. The theme is that there will be change.*

1. Students may choose either of the following to help them come to a definition of the term "energy."
   a. Students boil water, and investigate what happens to atoms and molecules. This should be followed by an explanation, in diagramatic form, of the breaking down of water.
   b. Using a test tube, a one-hole stopper, and glass tubing, drawn almost to a point, students could view the conversion of one kind of fuel to another.

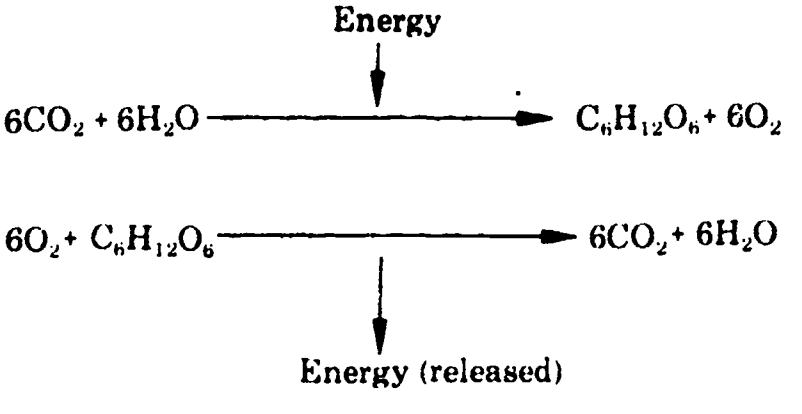
Procedure:

(1) Small pieces of coal or a wooden splint are placed into the test tube and the tube is sealed with the stopper containing the glass tube.

(2) A flame is applied to the outside of the test tube.

(3) After some time, a match applied to the small opening in the glass tube will glow with a pure flame (yellow), indicating the presence of hydrogen, and therefore, the conversion of coal or wood to its component carbon and hydrogen. (Left in the test tube should be charcoal, if the experiment is allowed to continue to completion.)

2. Students research the development of the fossil fuels and present their results in the form of a poster, chart, or frieze.
3. Using the following explanation of photosynthesis or a similar explanation, students are led to an understanding of the basic fossil-fuel cycle.



Briefly: In plants, carbon dioxide and water come together with an input of energy to form a carbohydrate and oxygen. When this carbohydrate is burned or oxidized, the energy is again released when that fuel is oxidized.

4. Students present reports on the types of energy listed below, and hold a debate about which is the best for solving our energy problems of the future.
   - hydrogen
   - geothermal
   - atomic
   - nuclear
   - air (wind-mill)
   - tides of oceans
   - solar
   - natural (plants, chemical reactions)
   - human
   - ionized gas plasma

ACTIVITY B: ENERGY INVESTIGATIONS

Teacher's Note:
Individuals or small groups investigating this topic may choose from the following suggested activities to learn more about their topic. Either of the activity sheets suggested before might be used to aid in student recording of their activities.

1. *Articles:* Find at least two articles on energy concerns and new methods of producing energy in the future. Write reports of the articles.
2. *Low Energy Day:* Think of all the ways that you might save energy in your home in one day (use no TV, use no radio, turn out extra lights, use small amounts of water for baths or washing, use fireplace and keep thermostat turned low). Ask your family to cooperate for one day at least. Report the results to the class and make suggestions of what might reasonably be done to cut down on energy waste in the future. List ideas.
3. *Letters:*
   a. Write to NASA, Lewis Research Center, to inquire about their proposed plan for a 100-kilowatt windmill to be built in 1975.
   b. Write to Solar Wind Company to inquire about the product they distribute (distributors for Swiss and Austrian windmills), and ask them about their plans for the future.
   c. Write to Integrated Life Support Systems, Wind and Solar Power, Prototype I, for information about their futuristic building and their plans for the future.
4. *Interviews:* Ask your mother and father if heating bills have gone up during the past year. If so, how much?

   Contact an official of a local electric company to ask how much and what kind of fuel is used in producing their electricity. Ask what problems the energy crisis has presented to them and how they plan to solve these problems in the future. Request figures on how much it costs in money and fuel to produce 1000 kilowatts of electricity and how many kilowatts are used by the individual in a year.
5. *Experiments:* (Students may choose any or all of the following.)
   a. Students separate water into hydrogen and oxygen and collect the gases.
   b. Students construct a solar reflector and measure the temperature increase using an alcohol thermometer.
   c. Students construct miniature greenhouses, use thermometers to measure heat build-up, and then devise a way to make this energy useful.
   d. Students prepare a demonstration of a hydro-electric dam scale model.
6. *Construction:* Construct your own windmill model using junk materials.

Materials:
Water disassociation apparatus.

ACTIVITY C: ENERGY CRISIS — SUMMARY

Students view slides on the energy crisis and discuss the pros and cons of this presentation.

The teacher should also use some of the articles listed below:

Bova, Ben. "Physicians Probe the Ultimate Source of Energy." *Smithsonian*, December, 1972. pp. 38-45.

Clark, Wilson. "Interest in Wind is Picking Up as Fuels Dwindle." *Smithsonian*, n.d., pp. 70-78. Article on the use of windmills and wind power to produce energy and how they may be used in the future.

"Energy Crisis: Are We Running Out?" *Time*, June 12, 1972. pp. 49-55. Article which examines statistics on use of oil, natural gas, and coal and explains alternative plans for producing energy in the future.

Lessing, Lawrence. "The Coming Hydrogren Economy," *Fortune*, November, 1972. pp. 138-146. Article which explains how the hydrogen cycle works more efficiently then the fossil fuel cycle and includes diagrams of both cycles, as well as a diagram and plan for use of hydrogen as fuel in the 21st century.

Looney, Douglas S. "The Age of Scarcity." *The National Observer*, November 3, 1973. pp. 1 and 7. Article and report on the "Future's Group's" predictions about shortages in our country and how they may affect our nation internally and in relation to foreign countries in the future.

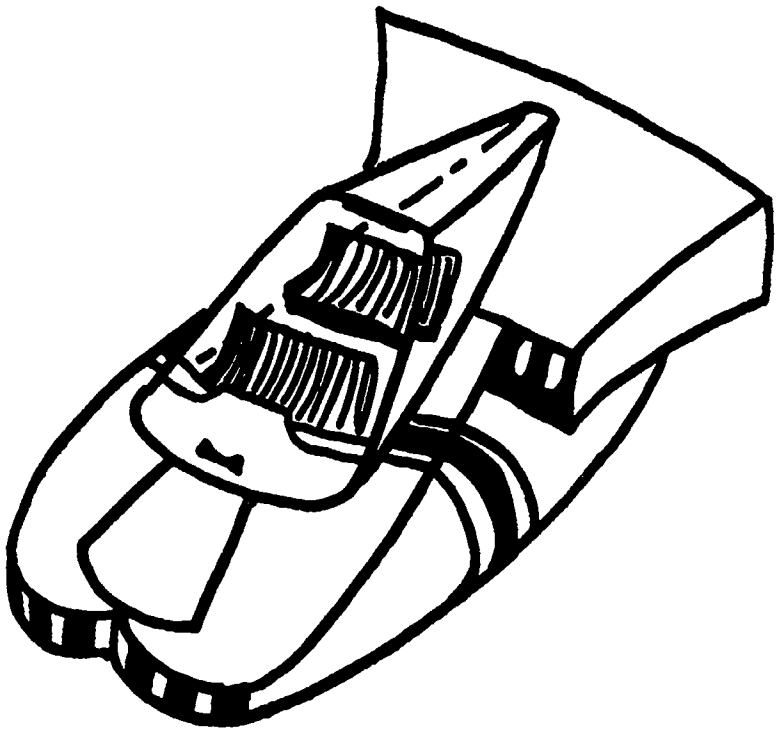
Audio-visuals pertinent to this section:

"Energy Crisis" filmstrips are purchasable from Gould, Inc.

Many movies on fossil fuels are available from the Bureau of Mines, Washington, D.C.

EXPERIENCE #4
TRANSPORTATION IN THE FUTURE

OBJECTIVE:
Students will learn more about present efficient transportation and "vehicles of the future."



ACTIVITY A:
FAMOUS PREDICTIONS OF THE PAST

Students discuss the predictions below:

1. Within 25 years nearly every family will have its own small airplane. (A common prediction of the 1930's)
2. The automobile will never amount to much. (A prediction of the late 1800's and early 1900's)

Students make their own predictions about transportation in the year 2025.

ACTIVITY B:
TRANSPORTATION: PAST, PRESENT . . .

A new public transportation system is being developed in Japan. The cars on this system run by electric-magnetic power. They do not touch the tracks, but they can go up to 250 miles per hour. Using two small magnets, students discover how electro-magnetic cars will work.

Students list all the means of transportation every known to man from the beginning of history up to the present time.

Questions:

1. Why did the automobile become so popular so fast?
2. What would be better than an automobile for future transportation?

ACTIVITY C:
TRANSPORTATION INVESTIGATION

Teacher's Note:
Individuals or small groups investigating this topic may choose from the following suggested activities to learn more about their topic.

1. *Articles:* Find, read, and write summaries of at least two articles which tell about transportation of the future.
2. *Trip:* Visit an airport to learn about traffic problems in the sky. Interview someone who can explain the traffic system and how it works. Ask what changes should be made to avoid air traffic problems in the future.
3. *Interview:* Interview people who live in the vicinity of a fairly large airport to get their reactions to problems caused by airplanes. Ask if they know of any way to improve the situation in the future.

   Interview someone connected with building or servicing jet planes. Ask if anything is being done to clear up the pollution problems caused by jets. What does the future hold?
4. *Letter:* Write to the Fire Department of Fire Island, New York, to find out why the Fire Island Fire Fighters use bicycles instead of trucks. Ask their reactions to them.
5. *Design:* Predict and design a means of public transportation for the future which will be convenient enough to encourage people to give up constant use of automobiles and will eliminate pollution. Do this in conjunction with the people who are investigating air pollution. Make drawings and perhaps a model.

Materials:

1. Several small magnets
2. Some of the following materials:

Chasan, Daniel Jack. "An Answer to City Traffic May Be a Horizontal Elevator," *Smithsonian*, July, 1973, p. 46. Article about several different kinds of new public transportation systems. Concentrates on 21 passenger driverless cars in Morgantown, West Virginia, but also mentions new systems planned for Denver, Colorado, ideas for other mass transit systems for New York City and Omaha, and developments for the future.

Childress, William. "Inventor William Lear goes All Out for Clean Steam," *Smithsonian*, June, 1973, p. 46. William Learn has developed a steam engine and new combustion chamber to run an automobile. Includes schematic drawing of the Lear Vapor Turbine System with a full explanation of how it works.

Hatch, Denis. *Cedarhurst Alley*. New York: Eriksson, 1972.

"No Place to Land: The Airport Crisis," *Reader's Digest*, March, 1973, p. 101. Article discusses the problems encountered by airport builders and describes the new Dallas airport.

Valentine, Tom. "Man Creates Engine That Consumes No Fuel," *The National Tattler*, July 1, 1973, pg. Edwin Gray invented motor powered by electro-magnetic power: produces energy without heat; high efficiency level; does more with less waste.

EXPERIENCE #5
OVERPOPULATION AND FOODS OF THE FUTURE

OBJECTIVES:

1. The student will realize the relationship between man and his environment.
2. The student will be able to draw conclusions concerning the necessary balance between an increase in food production and an increase in the population.
3. The student will understand the need for certain types of futuristic foods.

ACTIVITY A:
INTEREST BUILDERS

Teacher's Note:
Any of the following could be used to spark interest in this topic.

1. Prediction of the 1800's

   Students discuss the following prediction: The population of the U.S. cannot grow to be much greater than 100,000,000. There would not be enough pasture to support the horses needed for transportation by a larger population.

   Students report on answers to the following questions:

   a. How true has the above prediction been? What is the population of the U.S. today?
   b. What is the population of the world today? How fast is population growing?
   c. What future problems might result from this growth?
   d. What has caused this tremendous growth in population?
   e. What population figures are predicted for the future?

2. Students could view a filmstrip on the population explosion from the Time-Life series, *Crisis in the Environment*. This should be followed by a values-continuum discussion, ranging from "strongly agree" to "strongly disagree." Students could plot their own positions along this continuum and defend their positions in a class discussion.

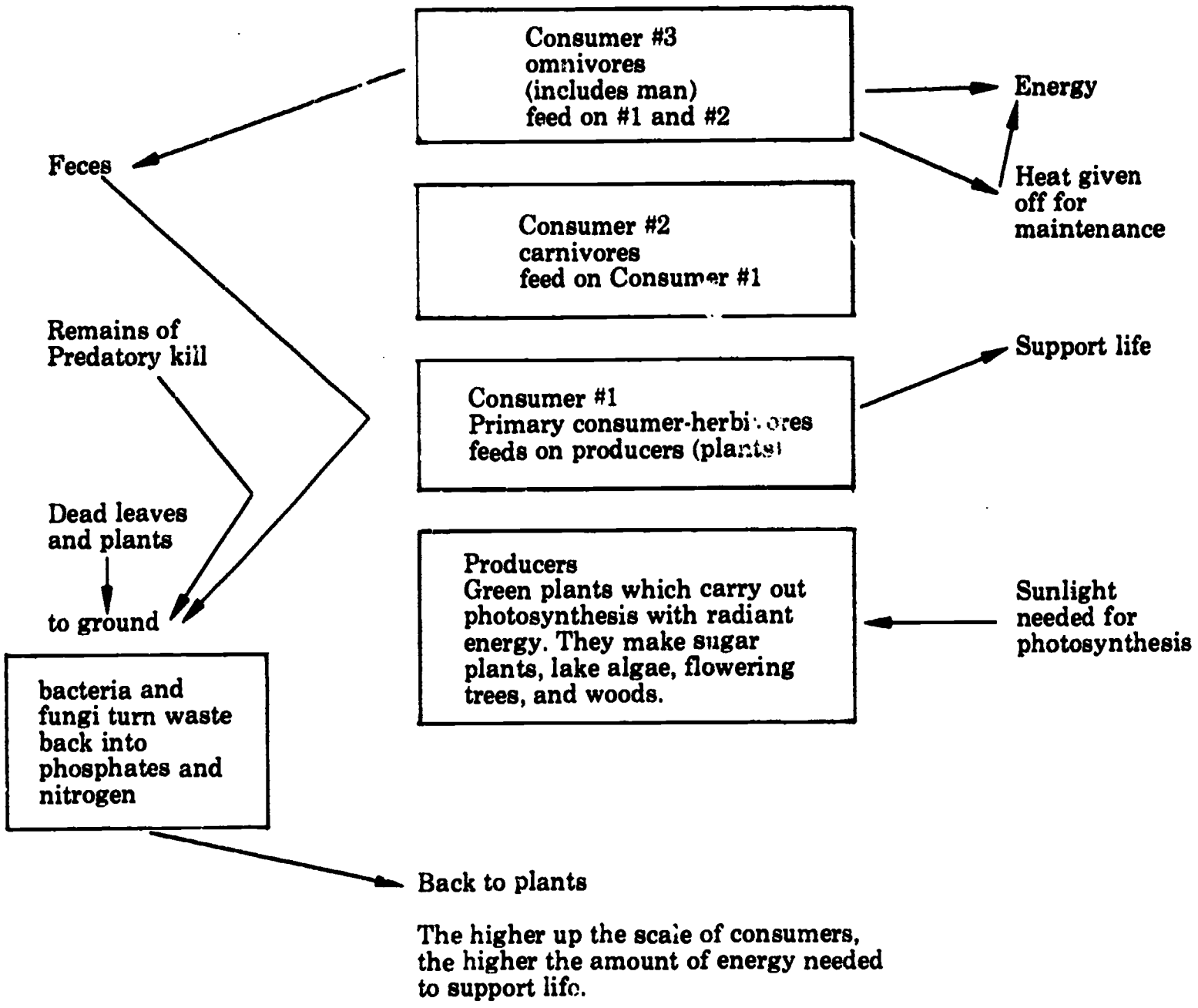
3. Role playing (Any of the following may be chosen.)

   a. Distribute a bogus bill for the Senate. Each student considers himself to be a senator. The bill is about families being limited to two children, with sterilization after the second child. Discuss pros and cons of this bill, with certain self-appointed proponents of the bill, and with some opposed to the bill.
   b. Situation given: A king on an island has the option of bringing a medical crew in to eliminate malaria and other diseases. If he does so he realizes his island will become overpopulated and many may starve. What should he do?
   c. Question: Should we discontinue cancer research to help limit our population?

ACTIVITY B:
INVESTIGATION

1. Look up world population figures and growth predictions.
2. Make up graphs of population growth since 1800 and of predicted growth.
3. Answer the question, "How will we eat in the future if population growth continues at this rate?"
4. What foods will we eat in the future?
5. Students examine eco-system diagram and draw conclusions about foods of the future.

DIAGRAM OF ECO-SYSTEM
AMOUNTS OF WASTE AND RESPIRATION



The higher up the scale of consumers, the higher the amount of energy needed to support life.

ACTIVITY C: ACTION

Teacher's Note:
Individuals or small groups investigating this topic may choose from the following suggested activities to learn about their topic.

1. *Articles:* Find articles about over-population and foods of the future. Read and write abstracts of these articles.
2. *Letters:*
   a. Write to the U.S. Department of Agriculture for information about use of farmland. Find out what kinds of foods will be used in the future if we have a real food shortage.
   b. Write to the U.S. Food and Drug Administration about information on substitute foods and foods of the future.
   c. Write to Stouffer Foods for information and/or samples of the new foods they are manufacturing to replace old.
   d. The following companies have been researching and manufacturing soy bean substitutes for meat in the future. Write for information and/or samples of futuristic meats: General Mills; Archer Daniels Midland; Gooch Foods Inc.; Miles Laboratories; Worthington Foods. (See appendix for addresses.)
3. *Menu:* Make up a menu of foods of the future, including explanations of what they are. Write on ditto sheets and pass out to the class. If possible, serve a meal of the future by buying or receiving samples of foods of the future.
4. *Trips:*
   a. If nearby, contact Stouffer Foods, Hudson, Ohio, for arrangements about a trip through their plant and an explanation of the kinds of foods they are manufacturing for space exploration and the future.
   b. Take a trip to a local health foods store to see what's "in store for the future."
   c. Visit a local grocery store to read labels on packages of food which now contain substitute ingredients. These will become more prevalent in the future. It might be helpful to have an interested parent accompany students on this trip and explain to the store manager the nature of the investigation. Many stores are wary of browsing teenagers.

Materials:
The teacher should be able to use at least several of the following articles:

Hellman, Hal. "Those Meatless Meats." Popular Science, October, 1972, pp. 78080), 164. An excellent resource for the explanation of the process involved in the production of meat substitutes.

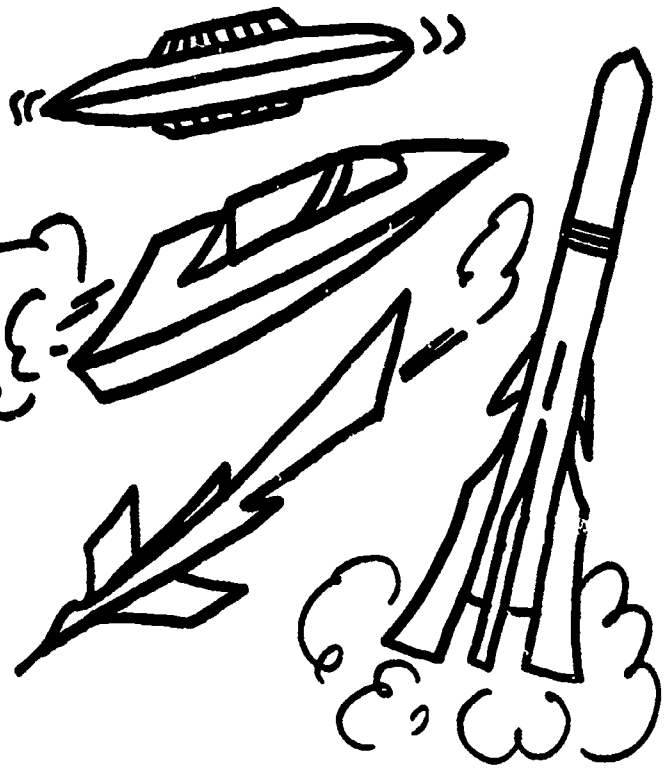
"New Challenges to World Hunger." *Life,* January 24, 1969, pp. 38-52. An excellent resource on new foods for the future. The special sections include many descriptive and informative illustrations.

"Now Remember the Ocystis Polymorpha . . . " *Esquire,* February, 1969, pp. 74-75. A menu for future meals with an explanation of where they will come from.

"Phoney Balony." *Newsweek,* August 7, 1972, pp. 47-48. A good summary of what is happening in the areas of vegetable proteins.

"The Superfood from the Sea." *Business Week,* November, 1970, pp. 112-114. An article about the development of fish protein concentrate to be used as a food additive.

"Why the Makers of Alka-Seltzer Want to Help Reduce Your Meat Bill," *Forbes,* April 1, 1973, 11. 112-114. Emphasizes the rush to make money on new foods.



EXPERIENCE #6
SPACE AND SPACE EXPLORATION IN THE FUTURE

OBJECTIVES:

1. Students will become aware of conditions on other planets and the possible use of these as life support systems.
2. The student will become familiar with travel in space for the future.

ACTIVITY A: INTEREST BUILDERS

1. Students look up the following information about another planet in the solar system: size, distance from the sun, distance from the earth, probable temperature, probable climatic conditions, gravitational pull, geographic features. Write up the information, then invent a being to suit the planet investigated. The being should fit the features of the planet as Asimov's Martian did Mars. Describe the being, then draw him (her, it).

2. Where will we travel in the future, and how far is it? On a long pice of ticker tape, students make a diagram of the sun and planets of the solar system in order to show the distance relationships between the sun and the several planets.

ACTIVITY B: INVESTIGATION

Teacher's Note:
Individuals and/or small groups investigating this topic may choose from the following suggested activities to learn more about their topic.

1. *Articles:* Find two or more articles about the future of space exploration. Read and write abstracts of these articles.
2. *Models:* Build a model of the solar system using styrofoam balls of different sizes. Color the balls to designate different planets.
3. *Letters:*
   a. Write to NASA about the future of space exploration and the reasons for space exploration.
   b. Write toTRW Systems Groupfor information about the project which they are working on in conjunction with NASA which may shed some light on the question of extra-terrestrial life.
4. *Trip:* Visit the nearest planetarium.
5. *UFO Collection:* Find articles about sightings of UFO's. In a notebook list briefly the following information for each one: Where, Date, Time, Description, Circumstances of Sighting, Who Sighted It, Results, and Reactions.
6. *Skit:* Write and present to the class a skit about a trip to another planet or into space. The script must contain information based on scientific fact about the universe, the planet, the distance, the speed of travel, length of trip, type of spaceship to be used and means of preserving life during the trip. It may become imaginary, but it must begin with facts.
7. *Origins:* Look up the theories of very early people about the origins of the universe (e.g. Biblical, Greek, Egyptian, American Indians). Then look up modern theories about origins of the universe and write a paper stating the theories and which seems most plausible.
8. *Egg Drop Invention:* In order to learn about the effects of gravity and to understand what kinds of protective devices might protect astronauts at the time of touchdown, students might invent devices which will protect a raw egg from breaking if it is tossed from the window of the highest story of the school. Protective devices should be small enough to fit into a shoe box, and should be made of junk or other materials not involving expenditures over 25¢. Complete directions for this experiment are available in several sources. (See bibliography.)
9. *Read:* Many imaginatively written articles about space and universe travel are available in literature books. They are listed in the bibliography.
10. *Read:* Read a science fiction story or book. Tell what part of the story is based on fact and where the author begins to extrapolate from science to imagination. (See bibliography.)

Materials:
The teacher may use the following articles:

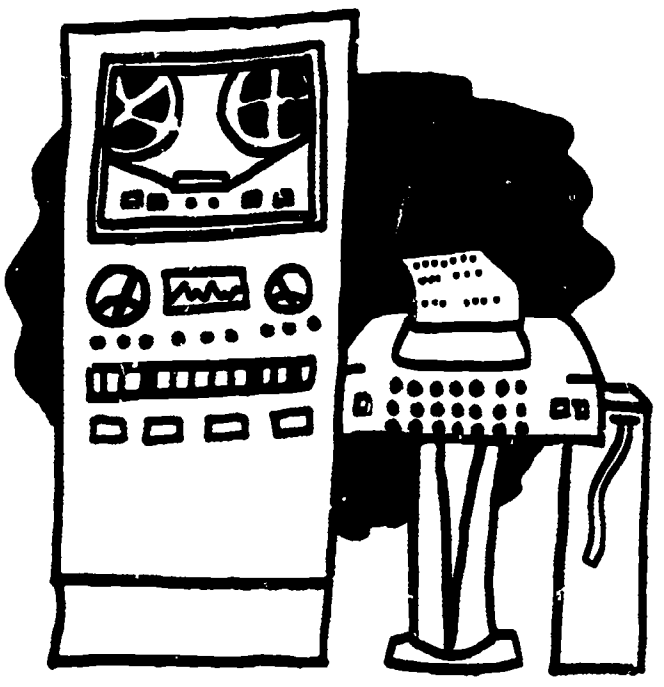
Bova, Ben. "Obituary of a Star," *Smithsonian*, July, 1973, pp. 54-63.

Brandt, John C. "The Solar Wind Blows Some Good for Astronomy," *Smithsonian*, January, 1973, pp. 30-35. Article tells about the history of research on the solar wind, explains its composition, and reveals some of the effects it has on earth.

Sagan, Carl. "A Detective Story in Astronomy: What Venus May Be Like," *Smithsonian*, September, 1973, 11. 64-71.

The students might use some of the following books:

Bradbury, Ray. *I Sing the Body Electric*, *Martian Chronicle*, and *R is for Rocket.*



EXPERIENCE #7
COMPUTERIZATION AND THE FUTURE

OBJECTIVE:
The student will learn how the computers could be used in the future.

ACTIVITY A:

1. The teacher should read aloud to the class sections of *The Andromeda Strain*, by Michael Crichton, which describe the physical examination given by the computer.
2. The class may have brain-storming sessions about all the things which computers may be used to do in the future. The article indicated in the "materials" section must be used.

Examples:
Communicating with computers: Type a question on a keyboard and the computer will print out an answer within a few seconds.

Dial a dinner: Through a computer service, whole meals might be ordered and delivered in the future.

A computerized newspaper in the home: Instead of buying a daily paper, people will be able to dial any phase of the news that they want to read about each day.

ACTIVITY B: INVESTIGATION

Teacher's Note:
Individuals and/or small groups investigating his topic may choose from the following activities to learn about the topic.

1. *Articles:* Find two or more articles about computers and what they will do in the future. Write summaries of the articles.
2. *Letters:*
   a. Write to the Public Relations Department, National Cash Register Company, Dayton, Ohio, for a computer kit that demonstrates how a computer works. Request information about future plans for computers.
   b. Write a letter to the Boston Museum, Boston, Massachusetts, to ask about the Honeywell Computer that plays logical games, solves math problems, and gives information about the museum. Ask about future plans for computers.
3. *Chess:* Send for a computer programed chess move game. Try to beat the computer at chess.
4. *Interview:* Interview the principal of a school where computers are used to make out report cards. Ask how the system works and whether the school intends to continue to use the computer system in the future.
5. *Visit:* Visit a computer center for a tour and ask the manager about what plans are being made for the use of computers in the future.
6. *Plan:* Plan and predict a method by which people will be able to shop in a nearby computerized center for goods which are available at a large center which is far away.
7. *Cartoons:* Many cartoons are available about the problems which computers cause to the ordinary "man-in-the-street." Make a collection of cartoons about computers, and paste them in a scrapbook. Under each cartoon write a comment about how this problem may affect our future life.
8. *Skit:* Write, practice, and present for the class a skit about robots which are controlled by a giant computer. Show the possibilities which exist for both good and bad effects of such a system in the future.

Materials: Article

Cusak, Michael, "Computers at the Check-Out Counter," *Science World*, November 1, 1973, pp. 9-11. Article about how computers work and what they may be expected to do in the future.

EXPERIENCE #8
FUTURE MAN

OBJECTIVES:

At the end of this experience, the student will be able to:

1. Examine the present state of man's medical and biological knowledge so that he may recognize the role of biological processes in man's development.
2. Discuss future developments in man's evolution and his knowledge of biological processes so that he may weigh alternatives and judge the problems and issues which may arise from such developments.
3. Present some predictions about future medical techniques so that he may assess the consequences of their application.

Teacher's Note:
Basic materials at the beginning of each activity should be discussed with the entire class. However, there are many options listed under the activities themselves. These may or may not be used, according to the discretion of the teacher.

Before you begin the next activity, you must discuss the following topics: (Material can be found in sources listed at the end of this section.)

Man, research and medicine today:

1. Progress in traditional basic sciences.
   a. anatomy
   b. biochemistry
   c. pathology
   d. pharmacology
   e. physiology
2. Progress in recently developed sciences of medicine
   a. biostatistics
   b. epidemiology
   c. medical economics
   d. medical sociology
3. Progress in disease research
   a. cancer
   b. birth defects — genetic defects
4. Progress in diagnostic techniques
   a. bio-chemical tests
   b. technological advances
5. Progress in surgical techniques

Themes: "There will be change."
"Is change progress?"

ACTIVITY A: MEDICAL RESEARCH TO DATE

1. Students research progress that has been made in the last 50 years in each of the basic medical sciences listed. Each group would be assigned a different science. Results would be presented by a panel.
2. Student groups research the history of the recently developed medical sciences and compare these histories with those of older sciences.

3. Have guest speakers from the March of Dimes, local research institutions, medical schools, doctors' associations, pharmacists, etc.
4. Take field trips to nearby hospitals, clinics, medical laboratories.
5. Students could report on progress in disease research. They could take an historical approach showing which have been conquered and which need to be conquered.
6. Students could do a time line showing the medical advances of the past 50 years.
7. Students could develop a visual presentation showing the increasing life expectancy of man over the past 100 years. (This could be a graph or time line.)
8. Students could conduct interviews with medical service personnel to get their views on progress in medicine.
9. Students could choose an advance in medicine and trace the effects of that man's life.
10. Students could trace the effects of research in one area on advances in another, e.g., research in immunology and advances in cancer research.
11. Students could design a filmstrip tracing the design changes in surgical instruments and their effectiveness.

Materials:
General reference books, health books, long sheets of paper, art supplies, filmstrip materials.

ACTIVITY B: MEDICAL POSSIBILITIES FOR THE FUTURE

Teacher's Note:
Discuss the following topics before you begin this activity.

Man in the future

1. *Future adaptations must be considered from the point of view of effects*
2. *Cloning*
3. *1984 thoughts*
   a. *cyborgs*
   b. *body factories*
   c. *sleep control*
   d. *thought control*
   e. *mood control*

1. Make a drawing of what a cyborg might look like. What purpose would a cyborg serve? Would a cyborg be human?
2. Discuss student reactions to cloning.
   a. What problems might arise?
   b. What would be the good points of cloning?
3. Teacher or students (depending on maturity level) may read sections from *1984. Brave New World*, or *Future Shock* and discuss class reactions:
   a. What ideas from this book appealed to you?

   b. What ideas did not appeal to you?
   c. How did you decide which ideas appealed to you and which did not?
   d. What are the possibilities for these things really happening?
   e. Are any of these possible in the present?
4. Have a teacher-led review of the theory of evolution, followed by student projections of its effects in the future. (could be presented visually)
5. Carry out student-developed role playing situations based upon the problems coming from these:
   a. thought control
   b. mood control
   c. sleep control
6. Student groups may brainstorm and list the possibilities presented by elimination of the aging process, genetic manipulation, cloning, etc., and then discuss.
7. Students present their concept of "Man in the Future."
8. The teacher could construct a value-tape activity based on any of the ideas presented in this section. Students would arrange themselves along the tape according to their initial reactions to the idea. Then discuss pupils' reasons for taking their positions, followed by an opportunity for students to realign themselves, if they so desire. The whole experience would be discussed.
   a. What was your original reaction?
   b. Did you change it?
   c. What influenced you to change your positions?
   d. If you did not change your position, why didn't you?
9. Students may conduct a poll of the general student body about their reactions to the ideas presented here and represent the results on a graph.

10. Students could analyze the problems and issues that may arise from any of the developments considered here and suggest solutions. The class could be polled for their reaction.

Materials:
1984, *Brave New World*, and *Future Shock*. Art supplies, large sheets of paper, graph paper or transparencies, long tape-like sheet of paper on the floor with the extremes and middle of the tape labeled.

ACTIVITY C:
NEW MEDICINE TODAY

Teacher's Note:
Have a discussion on the following topics:
New Medicine

a. Use of technology
(1) computer diagnosis
(2) laser surgery
(3) cyronics
(4) transplants - mechanical

b. Genetic manipulation

c. Brain stimulation

d. Elimination of aging process

e. Chemotherapy

f. Birth control

1. Student groups brainstorm the possibilities for the application of technology to medicine and then attempt to design some of the systems that might result.
2. Students develop skits illustrating the following:
   a. Visiting the computer-doctor
   b. Surgery without knives
   c. Freezing Daddy for the future, etc.

   Discuss class reactions to skits.
   a. How would you feel if you were in this situation?
   b. Can you think of alternative ways to end this skit?
   c. Would a different ending change your feelings about this situation?
3. Students present a visual histroy of the development of chemotherapy.
4. Students design a future hospital.
5. Students develop role playing situations in which they present those people who must decide whether or not to use brain stimulation, genetic manipulation, etc., in a particular situation.

   Discuss these questions:
   a. How did you feel about having to make this decision?
   b. Did you experience any conflict in reaching this decision? Why? Why not?
   c. What factors could have changed this decision?
   d. Does anyone make similar decisions now? Who? In what circumstances?

   Develop a roleplaying situation for these decisions.
6. Students develop lists of problems that they see arising in the future, solicit solutions from others students, post solutions, and have the class vote on the ones they think are the best.

   Discuss:
   a. Are people's values reflected in the solution they choose? How?
   b. What values are represented in the results of the class vote on solutions?
7. Students interview their parents to get their reactions to proposed medical advances.
   Discuss:
   a. Did your parents have the same reactions you did?
   b. How would you explain any differences in reactions?
   c. If you could see far into the future, would your reactions to developments then resemble your parent's reaction now?
   d. What determines a person's response to these ideas?
   e. Are people's responses to the idea of laser surgery the same as their responses to the idea of birth control?
   f. What could account for differences in reactions to these ideas?
   g. Students develop a list of criteria to be used in determining whether or not to implement a certain development. These could be compared and discussed.
      (1) What ideas do we find on everybody's list?
      (2) How do you explain this?
      (3) If we could only have three criteria, which would we choose? Why?
      (4) Is it necessary to consider the effects of an action before we do it? Why? Why not?

Materials:
Lists of criteria, student-developed interview questions, copies of discussion questions, paper, art supplies, large sheets of paper, magic markers

References: Books

Ettinger, R. *Man into Superman*. New York: St. Martins Press, 1972. Whole book would be helpful, but especially pp. 243-283. Teacher-reference: cryonics, morality, the present and the future.

Kahn, Herman and B. Bauce Briggs. *Things to Come: Thinking about the 70's and 80's*. New York: MacMillan Co., 1972, Chapters 6, 7, 8, 9. Teacher reference: ideas on the immediate future of the U.S.A.

Kunz, Robert M. and Hans Fehi. *The Challenge of Life*. Basel, Switzerland: F. Hoffman, LaRoche & Co., 1972. Teacher Reference: biomedical progress and human values; some foreign language contributions; technical.

Levine, Sumner N. *Advances in Biomedical Engineering and Medical Physics*. New York: Interscience Publishers, 1968, pp. 243-276; 279-313; 317-380.

Medawar, P.B. *The Future of Man.* New York: New American Library, 1961. Whole book, but especially Chapter 6, "The Future of Man." Teacher reference: biological speculations; genetic qualities of man in future.

Periodicals:

White, Kerr L., et al. "Life and Death, and Medicine." *Scientific American,* 299, No. 3, 1973. Whole issue deals with past, present, and some future ideas of man and medicine.

EXPERIENCE #9
ASSORTED TOPICS

OBJECTIVE:

At the conclusion of this experience, the student will be acquainted with various aspects of progress as they might apply the future.

Teacher's Note:
It is advisable for the teacher to discuss this experience in its entirety, but even if only some of the following topics are covered in class, it will give the students a chance to form general concepts about the future of these areas of life.

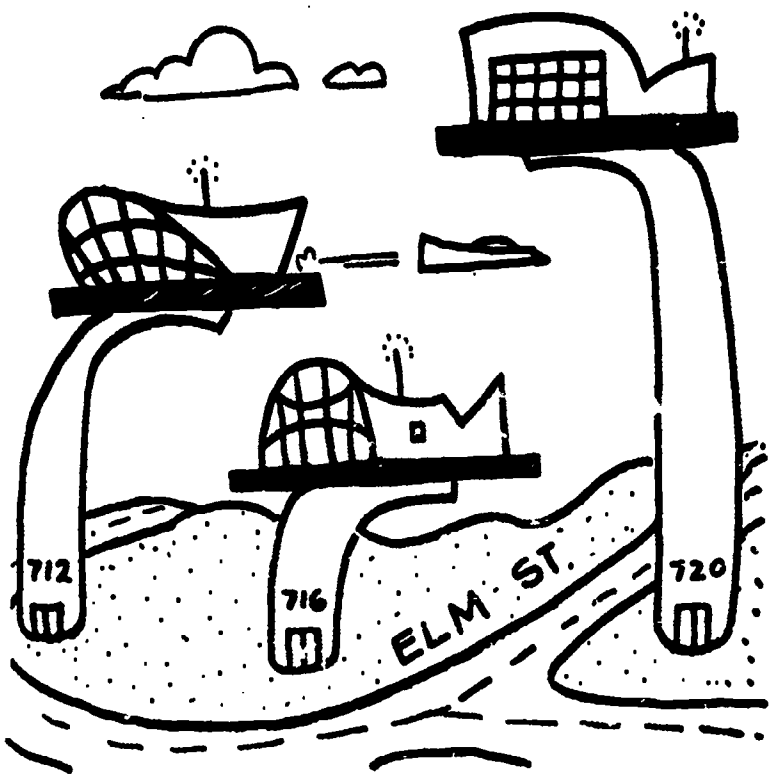
Some of the articles in the materials section must be used with this experience.

ACTIVITY A:
INDUSTRIALIZATION AND AUTOMATION

1. Make an assembly line submarine sandwich: Students each bring 50¢ to cover the cost of long loaves of French bread, thinly sliced cold cuts and cheese, shredded lettuce, sliced tomatoes, vinegar and oil dressing, and crushed red peppers. Form lines to assemble sandwiches assembly line style. Wrap slices of sandwich in waxed paper so the students can take them to lunch.
2. Make an assembly line booklet: Beginning with large sheets of white paper, have students cut, fold, and staple paper together to make small notebooks assembly line fashion.
3. Discuss implications of automation on the future.

ACTIVITY B:
DWELLINGS OF THE FUTURE

1. Students draw a picture/diagram from imagination of a dwelling of the future. If possible, draw it to scale using metric units.
2. Contact a furniture salesman or manufacturer to get information about furniture of the future.
3. Ask a representative of a local architectural organization to speak to the class about dwellings of the future which will make it possible to house more people on less land and will preserve green areas.



ACTIVITY C:
SOCIAL STRUCTURE IN THE FUTURE

1. Students have brainstorming session about the different ways of grouping people together for life. Write the list on the board and discuss the advantages and disadvantages of each for the future.
2. Read aloud to the class several of the short articles from "How Will We Raise Our Children in 2000 A.D. . . ." *Saturday Review of Education.* March, 1973.

ACTIVITY D:
EDUCATION IN THE FUTURE

1. Read aloud to the class the very short articles by Barret and Asimov in "How Will We Raise Our Children in 2000 A.D . . ."
2. Students discuss the "best" way of learning. How do they think school should be in the year 2000 A.D.?

   If possible, students read "The Fun They Had," Isaac Asimov's story of a girl in the computer age of the future who longs for the good old days at school with friends.

Materials:

"How Will We Raise Our Children in the Year 2000 A.D.?" *Saturday Review of Education,* March, 1973, pp. 28-37. A collection of very short articles which contain predictions for the future by Steinman, Giovanni, Graham, Bronfenbrenner, Hoffman, Janeway, Barret, Bettelheim, Leonard, Seale, Mead, and Asimov about social structure, education, and child rearing of the future.

Lester, Valie, "The War on the American Family," *Readers' Digest,* January, 1973.

Lester, Valie, "The Myth of the Vanishing Family," *Readers' Digest*, February, 1973.

Lester, Valie, "The Intimate Life of a Commune," *Readers' Digest*, March, 1973.

The three articles from *Readers' Digest* were written by a roving reporter who is investigating change in social structure in the U.S.A.

Medawar, Peter, "What's Human about Man is His Technology," *Smithsonian*, May, 1973, pp. 23-29.The author believes that man's problems which have resulted from technology can be solved and the gains man has made can be preserved by better use and management of that technology and by a technology of the future founded on ecology.

Robinson, John P., "The Living Laser," *Popular Electronics*, December, 1969. This article explains briefly how a laser works. It also contains a list and an explanation of the several types of laser beams. The same magazine has directions for building a safe, practical laser system for school or home and an explanation of how to use a laser beam safely.

EXPERIENCE #10:
BUILDING A MODEL CITY OF THE FUTURE
(Class Project)

OBJECTIVES:

As a result of cooperating in the planning and building of the Model City of the Future, the students will be able to:

1. Apply the knowledge gained through their individual/small group investigations of specific topics.
2. Plan a special area of the Model City of the Future.
3. Share and combine ideas with other students while working to plan and build the Model City.
4. Help to design and build a Model City of the Future.

Teacher's Note:

As this point students become "experts" on the topics which they have investigated individually or in small groups.

This project may be started in class before the individual/small group investigations are completed.

The whole class chooses a site for the city, following specifications and criteria.

Following the list of features to be included in the city, students pool their information on different topics and plan the city. The students who investigated transportation should plan the transportation system. Those who investigated water pollution plan the means of avoiding water pollution. Each student should have something to contribute to the overall plan.

After all plans have been made, the students draw their city on paper. They then actually build a model city of the future.

Complete directions for procedure, criteria, and building follow.

ACTIVITY A:
PLANNING AND BUILDING A CITY OF THE FUTURE

1. Students receive the list of criteria.
2. Students examine atlases to choose the site for the city.
3. Students write up all specifications for the city. Those who are knowledgeable on specific topics should suggest the specifications for the features which fit their topics.
4. Students draw a plan for their city on a large sheet of white paper, include everything that will be in the city, and color key the drawing to be sure that they know what each item is. Use metric units for distances.
5. Students build parts of the city separately and paint or color them if necessary. Use only throw-away items to build the city; no commercial items are permitted (e.g. those little houses and trees that are used in model railroad layouts.)

Materials:
scrap tin cans
egg cartons
milk cartons
straws
tooth picks
popsicle sticks
cottage cheese and sour cream containers
paper
glue and paint
styrofoam used for packing fragile items
throw-away flower pots

Note: Suggestions for city so that teacher may give explanations:

1. Dwelling will probably have to be high-rise apartments. On the roofs put recreation areas, green houses, swimming pools, and tennis courts. Use bicycles for individual transportation and bicycle paths. You must have grass and trees and very little concrete. Water runs off concrete. Without grass and trees there is no absorption of carbion dioxide or generation of oxygen. Provide electric vehicles, a mono-rail system, a subway system for transportation, and a travel center outside the city to rent cars, boats, motorcycles, recreational vehicles or to take a plane. Provide areas for each person to do personal gardening.
2. Building the City:
   Students make all the parts of the city as individual units. Do not try to put them all on a base. They usually turn out too big to do this. Set up the whole city on as large a space as is available. Then examine, criticize, and complement it.
3. Criteria for the Site
   Select a site for a city of ½ million people, large enough to be able to provide government, cultural, recreational, and educational services, but not too big to be unwieldy. Select a climate conducive to human comfort, one which provides raw materials available for heavy industry and a location at least 100 miles from any other metropolitan area. Remember to find a means of generating electricity and/or other power sources available. Existing transportation should be nearby, as should recreation facilities for outside recreation which needs large spaces, such as boating and skiing. A water supply should be available. The city must be contained within 100 square kilometers.
4. All specifications must be written in metric units.
   Specifications must include the following:
   - Housing allotment: size and types of homes
   - How people are grouped (age, interests, family?)
   - Where everything is located in the city according to the most efficient plan
   - Distances between things in the city
   - Amounts of water, power necessary in metric units
   - Amounts of waste water which will be produced
   - Building materials which are available on or near site
   - Exact location of the city: latitude and longitude
   - Climate of the location; waterways and mountains nearby; elevations
5. Model City of the Future must include the following features:
   - Heavy density for dwellings, high convenience transportation
   - Large amounts of open spaces within boundaries
   - Many parks and plantings (plantings to suit location of site)
   - Selection of major industries and subsidiary industries to fit site
   - A means of transporting the required materials if they are not available
   - No streets; only walking paths and small vehicle paths in concrete
   - Some type of futuristic transportation system which is convenient
   - No internal combustion engines for transportation within the city
   - Buildings which are made of materials which suit the site
   - Water supply — unpolluted; sewage disposal plant; solid waste use; recycling or disposal means
   - Governmental agencies; fire control, government, law enforcement
   - Occupations to employ at least 1/3 of the population
   - Cultural areas; recreation areas; hotels for visitors; restaurants
   - Elementary; high school; middle school; college educational plan (describe the educational system and the locations)
   - Libraries and other learning centers for those not in school
   - Shopping areas convenient to homes, larger central shopping area (consider computer shopping)
   - Computer system
   - Individual garden areas, patio and/or outdoor areas for all
   - Parking area on outskirts of city for visitors
   - Travel center to use in leaving city or returning
   - Outside — large space — recreation areas
   - Communications system within city; outside of city
   - Energy sources for heat, light, to be futuristic if possible

Materials:

Sources for material for information about the City of the Future

Atlases for choosing site (get them from the social studies teacher)

6. Write letters:
   a. Division of Housing and Urban Development, (HUD), Washington, D.C. Request information and statistics on present programs on city planning, development, and rejuvenation.
   b. Environmental Protection Association, (EPA), Rockville, Maryland. Request information about control of ecological problems.
   c. NASA, Lewis Research Center, Brookpark Road, Cleveland, Ohio. Request information on technological utilization.
   d. Chamber of Commerce, Reston, Virginia. Request information about their modern transit system to Washington, D.C.
   e. Mayor of the City, Chicago, Illinois. Request information about new apartment buildings above switching station of Illinois Central Railroad.
   f. I.B.M. Public Relations Department, Utica, New York. Request student kits on how a computer works.
   g. NASA, Lewis Research Center. Brookpark Road, Cleveland, Ohio. Request information or booklet on computer programming of software.

APPENDIX A:

Places to write for information and/or materials:

Glass Container Manufacturers Institute
Dept. H, 1800 K Street, N.W.
Washington, D.C. 20006

Request a copy of "The Glass Container Story" and any other available information on recycling glass.

TRW Systems Group
Attn: Marketing Communications, Ea/9043
One Space Park
Redondo Beach, California 90278

Write on *school stationery* for further information about the work TRW is doing to protect our environment from hazardous chemicals and to prevent water pollution in the future.

Aluminum Company of America
824-H Alcoa Building
Pittsburgh, Pa. 15219

Write for a brochure on energy and aluminum and a list of America's aluminum can reclamation centers with information about how one community established its center.

National Audobon Society
Dept. E 577
950 Third Avenue New York, N. Y. 10022

Audobon Society provides free material for schools presenting an ecology program.

EROS Data Center
(Earth Resources Observation Systems)
Sioux Falls, South Dakota 57198
or
Call 605-594-6511 to talk to a person who has his hand on the computer that turns out the photographs.

Photographs made and printed on a computer from a satellite 567 miles high available of almost anyplace on earth. You can get one of your section for as little as $1.75.

Kodak Company
Dept. 55W
Rochester, New York 14650

Request a reprint of an article about the computer mentioned above.

TRW Systems Group
Attn: Marketing Communications, E2/9043
One Space Park
Redondo Beach, California 90278

Write on *school stationery* for information about the work TRW is doing on a NASA project which may shed some light on the question of extraterrestrial life.

Tinplate Producers
American Iron and Steel Institute
150 East 42 Street
New York, N. Y. 10017

Write for booklet "Progress Report on Recycling" which tells about magnetic separation and how you city can join the effort in the future.

UOP, Universal Oil Products
10 UOP Plaza
Des Plaines, Illinois 60016

Write for information on the energy crisis. Ask for details: "UOP's Stake in the Energy and Environmental Crisis" and/or "UOP's Total Capabilities."

LIFE Educational Reprint Program
Box 834
Radio City Station
New York, N. Y. 10019

This company offers a booklet called "How the Computer Gets the Answer," at 50¢ per copy for an order of 15 plus a 75¢ handling charge.

East Ohio Gas Company
Box 57509
Cleveland, Ohio 44101

Write for a booklet on how to save gas.

Phelps Dodge Industries
300 Park Avenue
New York, N. Y. 10022
Public Relations Dept.

Write for information about a computer system now in use in Los Angeles, California, which warns motorists of traffic jams and accidents five or more miles ahead on the freeway.

National Wildlife Federation
Washington, D.C.

Write for information about their published report that yearly pollution damage runs about $480.00 per family, but the cost of a clean-up program for the environment would be only about $170.00 per family.

Fire Island Fire Fighters
Chief Mike Minski
Fire Island, New York

Write for information about the bicycle fire fighters of Fire Island.

Mr. Samuel R. Lane
Mr. W. C. Meecham
Engineers at the
University of California
Los Angeles, California

Write for information about the study these men did on hearing damage to junior high school students caused by jet planes.

Energy
Exxon Corporation
1251 Avenue of the Americas
New York, New York 10020

This company publishes a large, informative advertisement about potential energy sources for the future. They invite requests for more information.

NASA
Lewis Research Center
Mr. Calvin Weiss, Educational Director
Brookpark Road
Cleveland, Ohio

Write for information and plans for the future about these: Space exploration, Energy creating windmill for 1975, Water pollution testing kit, Air pollution.

Write to any of these companies to ask for information about why they support a switch to the metric system for the U.S.A.

Warner Swasey Company
Public Relations Dept.
Euclid, Ohio

General Motors Corp.
Public Relations Dept.
Detroit, Michigan

Ford Motor Company
Public Relations Dept.
Brookpark, Ohio

Atlantic-Richfield Oil Company
Public Relations Dept.
Philadelphia, Pa.

This company has published a series of attractive and interesting advertisements based on problems and how they will be solved in the future. They may be willing to send reprints of their ads.

Judd Ringer Corporation
6860 Flying Cloud Drive
Eden Prairie, Minnesota 55343

This company manufactures a compost culture which naturally changes dead leaves and plants to humus in a few months.

APPENDIX B:

METRIC EQUIVALENTS

LINEAR MEASURE

1 centimeter=0.3937 in.	1 in.=2.54 centimeters.
1 decimeter=3.937 in.=0.328 feet.	1 ft.=3.048 decimeters.
1 meter=39.37 in.=1.0936 yards.	1 yard=0.9144 meter.
1 dekameter=1.9884 rods.	1 rod=0.5029 dekameter.
1 kilometer=0.62137 mile.	1 mile=1.6093 kilometers.

SQUARE MEASURE

1 sq. centimeter=0.1550 sq. in.	1 sq. inch=6.452 square centimeters.
1 sq. decimeter=0.1076 sq. ft.	1 sq. foot=9.2903 square decimeters.
1 sq. meter=1.196 sq. yd.	1 sq. yd.=0.8361 sq. meter.
1 are.=3.954 sq. rods.	1 sq. rod=0.2529 are.
1 hektar=2.47 acres.	1 acre=0.4047 hektar.
1 sq. kilometer=0.386 sq. mile.	1 sq. mile=2.59 sq. kilometer.

MEASURE OF VOLUME

1 cu. centimeter=0.061 cu. in.	1 cu. inch=16.39 cu. centimeters.
1 cu. decimeter=0.0353 cu. ft.	1 cu. foot=28.317 cu. decimeters.
1 cu. meter = 1.308 cu. yard 1 ster = 0.2759 cord	1 cu. yard=0.7646 cu. meter 1 cord=3.624 sters.
1 liter=0.908 qt. dry. 1.0567 qt. liquid.	1 qt. dry=1.101 liters. 1 qt. liquid=0.9463 liter.
1 dekaliter=2.6417 gallons .135 pecks.	1 gallon=0.3785 dekaliter. 1 peck=0.881 dekaliter.
1 hektoliter=2.8375 bushels.	1 bushel=0.3524 hektoliter.

WEIGHTS

1 grem=0.03527 ounce.	1 ounce=28.35 grams.
1 kilogram=2.2046 pounds.	1 pound=0.4536 kilogram.
1 metric ton=1.1023 English ton.	1 English ton=0.9072 metric ton.

APPROXIMATE METRIC EQUIVALENTS

1 decimeter=4 inches.	1 liter=1.06 quart liquid. 0.9 quart dry.
1 meter=1.1 yards.	
1 kilometer=⅝ of mile.	1 hektoliter=2⅝ bushels.
1 hektar=2½ acres.	1 kilogram=2⅕ pounds.
1 ster. or cu. meter=¼ of a cord.	1 metric ton=2200 lbs.

REFERENCES:

TEACHER BOOKS:

Ettinger, R. *Man Into Superman.* New York: St. Martin's Press, 1972.

Kahn, Herman and B. Bauce Briggs. *Things to Come: Thinking About The 70's and 80's.* New York: Macmillan Co., 1972.

Kunz, Robert M. and Hans Fehi. *The Challenge of Life.* Basel, Seitzerland: F. Hoffmann, LaRoche & Co., 1972.

Levine, Sumner N. *Advances in Biomedical Engineering and Medical Physics.* New York: Interscience Publishers, 1968.

Medawar, P.B. *The Future of Man.* New York: New American Library, 1961.

STUDENT BOOKS

Asimov, Isaac. *Is Anybody There?* New York: Ace Paperbacks, Inc., n.d.

Borgstrom, George. *The Hungry Planet.* New York: Macmillan Co., 1972, chapters 18-19.

Breuer, Sandra and William F. Goodykuntz, ed. *Environment: Earth in Crisis.* New York: Scholastic Book Services, Inc., 1973. An easy to read collection which includes stories, plays, articles, and activities for studying the environment and the future of earth. This book is highly recommended because it direct students' thoughts to the future.

Crichton, Michael. *The Andromeda Strain.* New York: Dell Publishing Co., Inc., 1970. Science fiction novel about a five-day American crisis with an unidentified, lethal microorganism and a sojourn in a completely computerized research center. Many students might have seen the movie based on this book.

Ehrlich, Paul R. *The Population Bomb.* New York: Ballantine Books, 1971. Explanation of the causes and the results of over-population.

Honneger, Gottfried and Peter Van de Kamp. *Space: the Architecture of the Universe.* New York: Dell Publishing Co., Inc., 1962. Paperback which contains the history of the study of space from ancient Egyptian beliefs to modern times; the starts; the solar system; radiation and the spectra; architecture of the sun; the Milky Way; galaxies beyond our own; theories of origins. Interestingly and imaginatively written, beautifully illustrated, highly readable.

Kemeny, John G. *Man and the Computer.* New York: Charles Scribner's Sons, 1972. Book about computers, how they work and what fantastic things they may do in the future.

Sears, Paul B. *Where There is Life.* New York: Dell Publishing Co., 1970.

Smith, Leroi, ed. *We Came in Peace.* San Rafael, California: Classic Press, 1969. Includes a history of space exploration, the moon explorations, excellent photographs, diagrams of the solar system, a good bibliography, and other suggestions for future positions in space, space suits, and other protective devices.

Snyder, Ernest E. *Please Stop Killing Me.* New York: Signet, 1971.

Spiro, Melford. *Kibbutz: Venture in Utopia.* New York: Shocken Books, n.d.

ARTICLES

Asimov, Isaac. "The Fun They Had," *Adventures Ahead.* New York: Harcourt, Brace, and World, Inc., p. 81. Story of a girl who goes to school by machine.

Clarke, Arthur C. "Flight to the Moon," *Adventures for Readers, One.* New York: Harcourt, Brace, and World, Inc., 1963, p. 478. An imaginative tourist trip through space to the moon. Average reading ability for seventh and eighth graders.

Del, Ray. "Rocketship to Mars," *Adventures Ahead.* New York: Harcourt, Brace, and World, Inc., 1962, p. 260. Imaginary exploration of Mars by man — easy reading for seventh and eighth graders; can be compared to present and future data.

Dewellen, John. "Journey Through A Strange Country," *Adventures for You.* New York: Harcourt, Brace and World, Inc., 1962, p. 384. Imaginative journey into space which describes the effects of space on the human body - easy reading for seventh and eighth graders.

Toth, Robert C. "Island Universe," *Adventures for Readers, Two.* New York: Harcourt, Brace, and World, Inc., 1963, p. 510. Describes an imaginary space flight to the farthest reaches of the universe; helpful in showing distances in the universe — difficult.

PAPERBACKS

Christopher, John. *The Lotus Caves.* New York: Collier Books, 1969. Average, but contains some difficult concepts.

Conklin, Groff, ed. *Great Stories of Space Travel.* New York: Grosset and Dunlap, Tempo Books, 1962. Difficult.

Greene, Joseph. *The Forgotten Star.* New York: Golden Press, Golden Griffin Mystery, 1969. Easy.

Heinlein, Robert. *The Farmer In The Sky.* New York: Dell Publishing Co., n.d., Average.

Silverberg, Robert. *Revolt on Alpha C.* New York: Scholastic Book Services, 1960. Easy.

PERIODICALS

Bova, Ben. "Obituary of a Star," *Smithsonian*, July, 1973, pp. 54-63.

Bova, Ben. "Physicists Probe the Ultimate Source of Energy," *Smithsonian*, December, 1972, pp. 38-45.

Bradnt, John C. "The Solar Wind Blows Some Good For Astronomy," *Smithsonian*, January, 1973, pp. 30-35.

Chasan, Daniel Jack. "An Answer to City Traffic May be a Horizontal Elevator," *Smithsonian*, July, 1973, p. 46.

Childress, William. "Inventor William Lear Goes All Out for Clean Steam," *Smithsonian*, June, 1973, p. 46.

Clark, Wilson. "Interest in Wind is Picking Up As Fuels Dwindle." *Smithsonian*, n.d., pp. 70-78.

Cusak, Michael. "Computers at the Check-Out Counter," *Science World*, November 1, 1973, pp. 9-11.

"Energy Crisis: Are We Running Out?" *Time*, June 12, 1972, pp. 49-55.

Gates, Richard W. et al. "Look Out Below!" *Grade Teacher*, April, 1970, p. 74.

Hellman, Hal. "Those Meatless Meats," *Popular Science*, October, 1972, pp. 78-80, 164.

"How Will We Raise Our Children in the Year 2000 A.D.?" *Saturday Review of Education*, March, 1973, pp. 28-37.

Lessing, Lawrence. "The Coming Hydrogen Economy," *Fortune*, November, 1972, pp. 138-146.

Lester, Valie. "The War on the American Family," *Reader's Digest*, January, 1973.

Looney, Douglas S. "The Age of Scarcity," *The National Observer*, November 3, 1973, pp. 1 & 7.

McCormack, Alan J. "Egg Drop," *Science Activities*, October, 1973, p. 20.

Medawar, Peter. "What's Human About Man is His Technology," *Smithsonian*, May, 1973, pp. 23-29.

"New Challenges to World Hunger." *Life*, January 24, 1969, pp. 38-52.

"No Place to Land: The Airport Crisis." *Reader's Digest*, March, 1973, p. 101.

"Now Remember the Ocystis Polymorpha . . ." *Esquire*, February, 1969, pp. 74-75.

"Operation Eggdrop." *Science and Children*, November, 1968, pp. 7-9.

"Phoney Balony." *Newsweek*, August 7, 1972, pp. 47-48.

Robinson, John P. "The Lively Laser," *Popular Electronics*, December, 1969.

Sagan, Carl. "A Detective Story in Astronomy: What Venus May Be Like" *Smithsonian*, September, 1973, pp. 64-71.

"The Egg Drop Experiment: Absolutely Mad Inventions." *Science Activities*, April, 1973.

"The Superfood From the Sea." *Business Week*, November, 1970, pp. 112-114.

Valentine, Tom. "Man Creates Engine that Consumes No Fuel," *The National Tattler*, July 1, 1973, p. 5.

"Why the Makers of Alka-Seltzer Want to Help Reduce Your Meat Bill," *Forbes*, April 1, 1973, pp. 112-114.

FREE FILMS SUGGESTED FOR BACKGROUND INFORMATION

Project 70 — Available from Sohio Oil Company, a series of films that show what life is like now in the city and what it may be in the future. It offers ideas for future city planning.
Films include: Transportation (includes air pollution), Housing, Urban Renewal, Energy, Water Pollution.

Franklin, Ohio — Available free from Geauga County, Ohio; film about a new re-cycling plant for trash and garbage. The process sorts out different components automatically for separate purposes. A futuristic plan.

Future Shock — For teachers, McGraw-Hill Publishing Company. Available through the Ohio Education Association. Some local mental health agencies have copies. This film summarizes the ideas in Alvin Toffler's book.

MAGAZINE

The Smithsonian — a publication of the Smithsonian Institution, Washington, D.C., is sold as a means of supporting the Institution. It is most certainly worth the $10.00 price. The Smithsonian Institution might be willing to send back copies for reduced fees.

Schools participating in the pilot program between February 1, 1974 and March 31, 1974

Akron City Schools
- Buchtel High School
- North High School
- Goodyear Junior High School
- Jennings Junior High School
- Kent Junior High School
- Perkins Junior High School

Chardon Local Schools
- Chardon High School
- Chardon Middle School

Cleveland Diocesan Schools
- Byzantine Catholic High School
- Cleveland Central Catholic
- Cathedral Latin High School
- Lake Catholic High School
- Notre Dame Academy
- St. Edward High School
- St. Joseph Franciscan School
- St. Justin Martyr
- St. Mary School
- St. Michael School
- St. Patrick School
- St. Richard School
- St. Rose School
- Trinity High School

Cleveland Heights/University Heights City Schools
- Heights High School
- Monticello Junior High School

Columbus City Schools
- Central High School
- Eastmoor Senior High School
- Linden McKinley High School
- Mohawk Senior High School
- North High School
- Eastmoor Junior High School
- Everett Junior High School
- Linmoor Junior High School
- Starling Junior High School
- Yorktown Junior High School

Euclid City Schools
- Euclid Senior High School
- Forest Park Junior High School
- Shore Junior High School

Geneva Area City Schools
- Geneva Area Senior High School
- Geneva Area Junior High School

Kirtland Local Schools
- Kirtland High School

Ledgemont Local Schools
- Ledgemont High School

Madison Local Schools
- Madison High School
- Memorial Middle School
- Red Bird Middle School

Mayfield City Schools
- Mayfield High School

Painesville Local Schools
- Riverside High School

Perry Local Schools
- Perry High School

West Geauga Local Schools
- West Geauga Junior High School

Willoughby-Eastlake City Schools
- North High School
- Kennedy Junior High School
- Willowick Junior High School

Youngstown City Schools
- North High School
- Haynes Junior High School
- Hillman Junior High School
- Princetown Junior High School

CONSULTANTS:

William Foisel, Teacher
Shore Junior High
Euclid City Schools
Euclid, Ohio

Charles Cuthbert, Teacher
Monticello Junior High
Cleveland Heights/University Heights Schools
Cleveland, Ohio

Larry Hardgrove, Teacher
Chardon Middle School
Chardon, Ohio

David Massaro, Teacher
Chardon Middle School
Chardon, Ohio

Sarah Griffin, Teacher
Hillman Hunior High
Youngstown City Schools
Youngstown, Ohio

Elliot Ross, Asst. Principal
Lincoln Junior High
Cleveland City Schools
Cleveland, Ohio

Vernon Bowman, Asst. Superintendent
Chardon Local Schools
Chardon, Ohio

Kenneth Wulff, Professor
Kent State University
Kent, Ohio

Robert McNemar
Science and Mathematics Director
Columbus City Schools
Columbus, Ohio

Dr. Herbert Coon, Professor
The Ohio State University
College of Education
Columbus, Ohio

Dr. Robert Roth, Assoc. Professor
School of Natural Resources
The Ohio State University
Columbus, Ohio

Angela Buller, Teacher
St. Richard School
Cleveland Dioceasan Schools
Cleveland, Ohio

Ruth Melvin, Geologist
Ohio Academy of Science
Columbus, Ohio

Alan M. Voelker, Assoc. Professor
Science Education
Northern Illinois University
DeKalb, Illinois

William Stapp, Professor
School of Natural Resources
University of Michigan
Ann Arbor, Michigan

Dean Freund, Director
Environmental Education
Worthington City Schools
Worthington, Ohio

Dr. Craig Chase, Professor
Environmental Education
Slippery Rock State College
Slippery Rock, Pennsylvania

The work presented or reported herein was performed pursuant to a grant from the Ohio Department of Education, ESEA Title III Office. However, the opinions expressed herein do not necessarily reflect the position or policy of the Ohio Department of Education, and no official endorsement by the Ohio Department of Education should be inferred.